the welding engineer

PIONEER BUSINESS AND TECHNICAL JOURNAL OF THE WELDING INDUSTRY

November
1941

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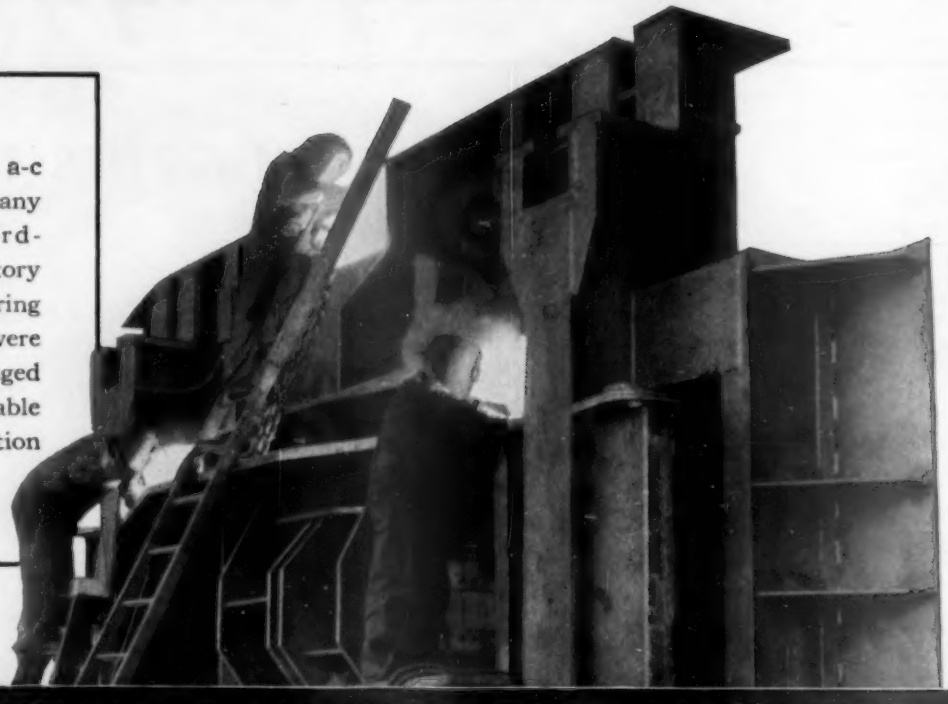
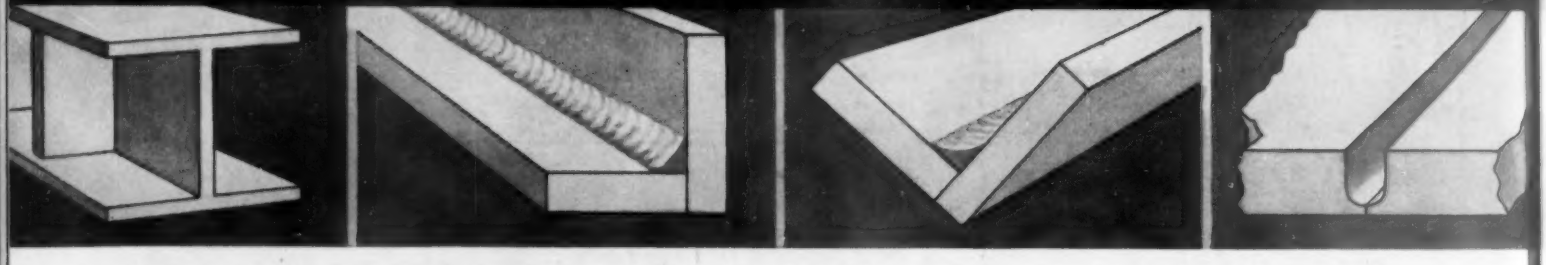
WHILE not a cure-all, a-c welding *has* helped many operations that were hard-pressed to show a satisfactory profit. Countless shops, desiring higher speeds than they were getting with d-c, have changed over to a-c with very profitable results in reduced production time and improved welds.



INCREASE YOUR PRODUCTION AND PROFIT ON JOINTS LIKE THESE



Welding In Corners — where magnetic blow prevails—reworks and rejects of unsound welds caused by magnetic blow are reduced to the minimum with a-c welding. The use of higher currents and larger electrodes on work like this also results in faster welding.

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If You Weld Deep-groove Butt Joints, where large electrodes, high deposition rates and thorough penetration are paramount factors, a-c welding offers many advantages in speed and finished quality that are impossible to obtain with d-c. The uniform, sound welds obtained with a-c on this type of work are readily indicated by an improved appearance and are *proved* by testing and X-ray inspection.

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New 300-amp a-c welder, transformer type, similar to the 500-amp size. Running gear for portability is available.

Brazing in the Railroad Shop

Brazing in its many different applications is the most versatile and probably the most extensively used maintenance tool of the railroad. In this article there is described some important but little known applications.

By

ARTHUR HAVENS

VIRTUALLY hundreds of malleable castings and worn parts would be relegated to the scrap heap if it were not for bronze welding rod and brazing methods. Torch applied bronze is often found advantageously used in replacing poured bronze or other metal wearing surfaces. It has even been found beneficial to apply bronze to a bearing designed for a hardened steel pin and bushing.

An example of the latter is found in an application of bronze to the body of the locomotive link block pin. This bearing, designed for hardened steel pin and bushing, is subjected to severe abrasive wear due to its position on the locomotive. As it is located near the front over the drivers, the link block is constantly exposed to road bed grit causing serious bearing wear. It is not uncommon for this part to freeze and gall so severely that extensive repairs are needed and operation delays incurred.

This condition is easily and satisfactorily remedied by providing a bronze wearing surface on the link block pin. This is accomplished by undercutting the body of the pin ⅛ in. and depositing by brazing, a layer of wear resisting bronze. The pin is then machined to size.

This wear resisting operation can be speeded by placing the pin on a pair of centers on the welding bench where it will be free to be turned at the wish of the weldor. Bronze surfaced pins have given such splendid service on a railroad in New England that they have been accepted as standard.

During the general repair of a group of new K engines, the Standard stoker engine was removed and thoroughly overhauled. It was discovered, during this overhaul, that the stoker piston rods were so badly worn that it would be necessary to replace them. Since securing new ones at this time seemed impractical, it was decided to rebuild them. The pistons finally were taken to the weldor who was instructed to deposit a layer of wear resisting bronze the length of the rod, the rod having previously been undercut for this purpose.

A holder similar to the one used for link block pins was made for the stoker pistons. Before starting welding, the weldor marked the rod off into three equal lengths. Each section was then brazed separately and in this manner warpage was held to the minimum. The rods were then finished in a lathe, where they were straightened if necessary, and turned to the proper size. Needless to state, this method of repair was found successful and the original pistons in these same stoker engines are still giving satisfactory service, although they are over ten years old.

Occasionally the use of bronze on a locomotive frame will tide an engine house foreman over a tight spot. While this method of repairing locomotive frames is not recommended for permanency, it will often save a locomotive tie-up at a critical moment. Such breaks frequently occur near a remote engine house where it is necessary for one weldor to make the weld alone. In this event frame is "V'd" from one side only. Some expansion is secured, if possible 3/32 to ⅛ of an inch. An operator need not be alarmed if he cannot get any expansion because these bronze welds seem to have a faculty of holding regardless.

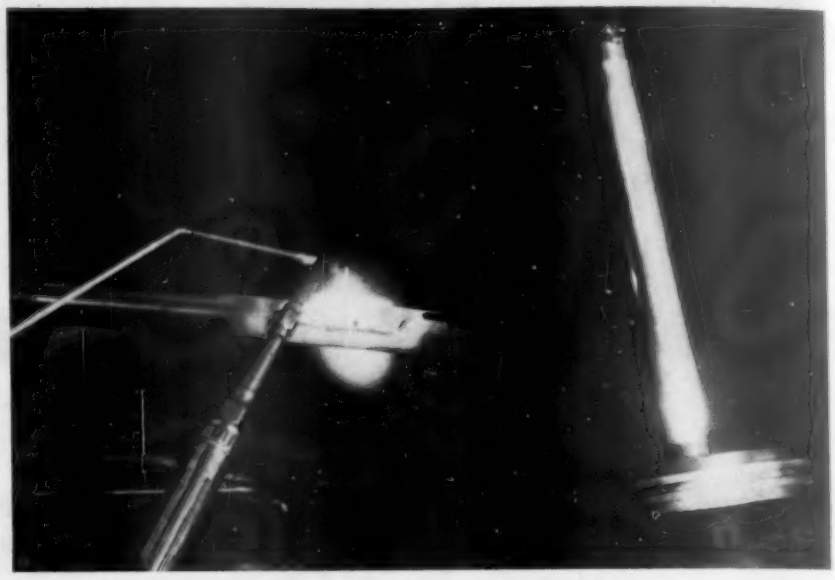
Some weldors have difficulty holding the bronze in a single V frame weld. An aid to this may be found in the following: Cut a number of pieces of 3/16 or ¼ in. plate into strips ¾ in. wide and long enough to lap over the edge of the "V" a strong inch. These strips are then bent to conform to the curve of the proposed reinforcement. When the bottom plate is fastened in place one of the

strips is held till it is secure; this acts as a dam till it is full of bronze, another strip is then held in place and so on until the "V" is full. This saves losing a lot of valuable bronze, also a lot of time. This makes a good roundhouse repair and when the locomotive is shopped for general repairs the bronze weld can be removed and a new section of steel substituted.

Crosshead Valves

The wearing surfaces on most valve crossheads are covered with so-called hard babbitt. This babbitt metal frequently falls out of the crosshead in large pieces necessitating removal of the part for rebabbitting. By taking a little more time and spending a little more money this condition can be entirely eliminated. This is done by depositing by brazing a wear resisting bronze in place of the babbitt. When applying bronze to any surface that will require a depth of finished metal of 3/16 in. or more, the article or part should be so arranged as to present a side hill effect to the weldor. It is then a simple matter to build to quite a thickness with one pass. Otherwise the weldor will have to go over the same area several times to reach the required thickness.

In most railroad shops you will find near the bench where inspirators are repaired, a large box of junk. Scattered among these discarded parts are generally a few forcer steam valves. The forcer valves have been laid to one side because after frequent machining the seat will not match an injector which has had the seat reamed several times.



Brazing Standard Stoker Piston Rods.

The seat on the forcer steam valve can be rebuilt with wear resisting bronze, machined to the proper length and it will be fully as useful as when new. One precaution: The stem of the slide valve on the end of the forcer valve extends into the cage or body of the valve. When brazing the seat, the heat from the torch has a tendency to melt the end of the slide valve. To avoid this, tear some asbestos paper into ½ in. strips and bind the end of the slide valve with the paper. This will prevent the stem from becoming overheated and melting. Usually ½ in. of new metal will insure perfect machining. Since the ribs of the forcer valve are extremely light, a weldor will have to be careful to avoid burning them.

Bronze welding locomotive driving box hub faces has been a great success on some roads, others have had no end of trouble with this application. The large driving boxes on the more modern locomotive have a very wide hub face and when huge pieces of the poured liner fall off it leaves a large space on the box unprotected. If the brazed hub face simply eliminated this condition, it would be sufficient to warrant its use. It not only does this effectively, but it adds many miles to the wear of the box. In fact, it is not uncommon to replace worn crown brasses in driving boxes without touching the brazed hub face.

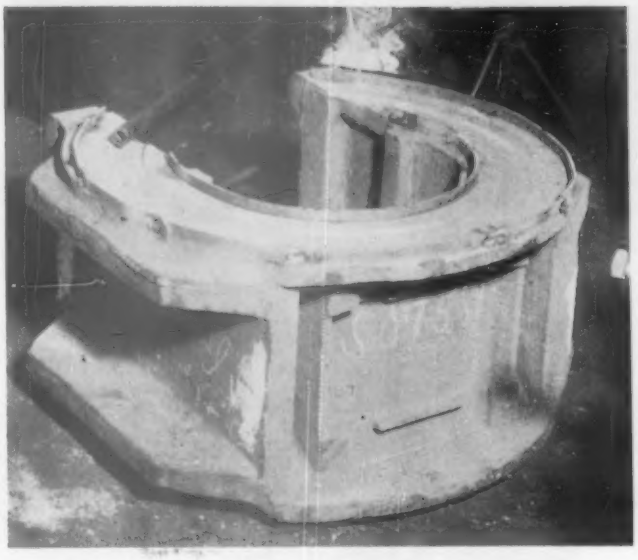
Driving Box Repairs

Proper preparation for this application, like most others, is needed for complete success. When using new boxes, this is simple. All that is needed is to machine or grind bright the area to be brazed. When using old boxes with a deep groove made for the poured liner, it is wise to fill the groove first. Experience has taught that the best and cheapest way to do this is to arc weld the groove level full. This can be done quickly using a ⅜ in. heavy coated steel electrode. When the groove is filled all flux is removed and the surface ground bright. A piece of 3/16 in. x ½ in. boiler steel or band iron is bent into a circle of the correct diameter to encircle all of the area to be brazed. This band or dam is tacked to the box with the arc, spacing the tacks about 4 in. apart. If the crown brass is in place this box is ready for bronze. In the event that the crown brass has not been applied a dam must be arranged in the crown brass fit. A piece of 3/16 in. x 1 in. band iron bent to

Locomotive Link Block Pins with Welded Bronze Bodies.

the circle of the flange on the crown brass is tacked in place. The bronze can now be deposited in the box with ease. Because the driving box is such a solid mass a welding head with a large orifice is needed, usually one about 5/32 in. diameter is correct.

Brazing is generally started on one side near the cellar pin hole. Tinning the box several inches ahead of the actual brazing helps the operator to secure good adhesion. The bronze is applied tapering slightly, reaching the full thickness in about three inches. From there around the box the space between the dams is filled level full. The tip should be held at right angles to the work, for with the large puddle used in this application it is a simple matter to include a large cold shut in the brazing. Special 3/8 in. rods are used for this work, and when the box is sufficiently hot two or even three rods can be used at one time.



Tacking a "Steel Dam" on the Driving Box Prior to Brazing Operation.

Rebuilding Crown Brasses

Occasionally driving box crown brasses are removed and scrapped simply because the brass has loosened in the box. Ofttimes a shim is placed in back of the brass and the brass used again. Rebuilding the sides of the crown brass with a layer of bronze and machining the brass can be made to fit as good as new. This saves scrapping a perfectly usable crown brass.

The above method in a slightly different form applies to butt-end brasses. Butt-end brasses are prone to develop too much lateral play. It seems a shame to scrap a good brass casting just because of this lateral wear, and it is not necessary. All that is needed is to apply a good heavy layer of wear resisting bronze on the side having the wear, place the brass back in the boring mill, face it off to the proper thickness and the brass is ready for many more economical miles.

Applying an eighth inch Coating of Bronze after 150,000 Miles of Service.

Injector Bodies

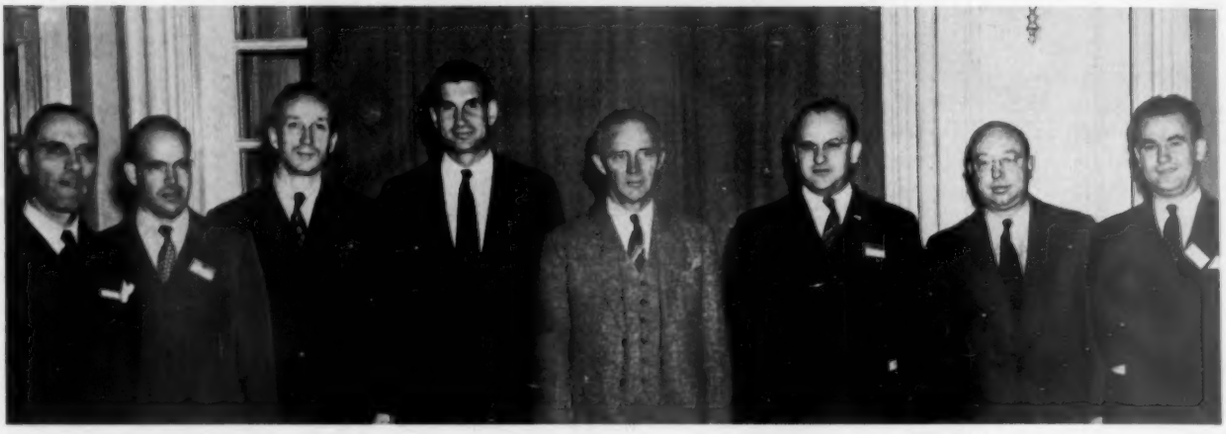
Although most of this article has been devoted to rebuilding worn surfaces, many broken brass castings are reclaimed by brazing. Lugs broken from injector bodies are brazed on or rebuilt. Cracked bodies are chipped out and brazed and when tested they are found to be fully as good as new ones.

Not long ago the body of an exhaust steam injector was so badly cracked, the bolting lugs broken and worn, that the management decided to throw the body away. Instead, however, an enterprising weldor proceeded to chip out the cracks and grind and chip the broken lugs. When all was in readiness, he attached a large tip to the torch and played the flame on the casting for some time. When the casting had been preheated all over he substituted a smaller tip and welded the cracks in the body. After this the casting was again heated for a few minutes and the broken lugs were welded. The holes in the remaining lugs were filled for redrilling and the casting was complete. It was tested and found to be free from leaks and o.k. for use.

The foregoing are just a few of the not so common uses of brazing. There are a great many more. In fact, there is seldom a day goes by that the railroad weldor does not have several brazing jobs.

THE END

A. W. S. Meeting Highlights



A few of the recipients of prizes in the Resistance Welder Manufacturers' Association gather for a picture at the AWS convention. They are from left to right: M. S. Clark, Federal Welder & Machine Co., president, RWMA; G. N. Weygandt, Rensselaer Polytechnic Institute; G. S. Mikhalapov, Dir. of Research, Taylor-Winfield Corp; John Fetcher, E. G. Budd Co.; Prof. W. B. Kouwenhoven, Johns Hopkins University; A. M. Unger, Pullman Standard Car Mfg. Co. and M. L. Wood and J. Babin, Chase Brass & Copper Co.

Records were broken in Philadelphia. This year's meeting of the American Welding Society enjoyed the best in attendance and papers in the 22 year history of its meetings.

THE records of all times were shattered at the 1941 Metal Congress and Exposition and the 22nd Annual Meeting of the American Welding Society which were held in Philadelphia, October 20th to 24th. With over 300 exhibitors, occupying 109,000 sq. ft. of exposition space, the Metal Exposition was the largest to be held in the 23 years of its existence. Similarly, a total registration of over 1725 set an all time high for an Annual Meeting of the American Welding Society. There were 63 papers presented in 19 technical sessions; in addition there was a session for: The Presentation of Awards; Industrial Research Conference; Fundamental Research Conference; Committee meetings for District and Society Officers and the Society's Annual Business Meeting.

The Society Awards

Presentation of the 1941 Miller Memorial Award and the Lincoln Gold Medal for 1940-41 featured the opening session of the American Welding Society's annual meeting held at Bellevue-Stratford Hotel. The Samuel Wylie Miller Memorial Medal was awarded to David Arnott, vice-president and chief surveyor of the American Bureau of Shipping, New York, N. Y., and second vice-president of the American Welding Society. Mr. Arnott, whose long service with the American Bureau of Shipping began in 1918, was awarded the Miller Medal for conspicuous contributions to the art and science of welding in the shipbuilding field.

Robert H. Aborn, a member of the staff of the Research Laboratory, United States Steel Corp., Kearney, N. J., was awarded the Lincoln Medal donated to the American Welding Society by James F. Lincoln, president, Lincoln Electric Co., Cleveland, Ohio. This award, which is presented each year for the paper which contributes most to the year's development of welding, was made for Mr. Aborn's paper "Metallurgical Changes at Welded Joints and the Weldability of Steel" which was presented at the 1940 Annual Meeting of the Society.

RWMA Prizes

The awards by the Resistance Welders' Manufacturers Association, Philadelphia, for papers contributing to progress in resistance welding were made as follows: First prize, $300.00 —jointly by A. M. Unger, K. A. Matis and E. P. Crucs, all associated with Pullman-Standard Car Manu-

C. H. Jennings, Westinghouse, (extreme left) chairman, AWS awards board with Col. G. F. Jenks, president AWS presenting the Lincoln Gold Medal to Dr. R. H. Aborn, U. S. Steel Corp., Kearny, N. J. (center) while David Arnott, American Bureau of Shipping, recipient of the Samuel Wylie Miller Memorial Medal and Dr. D. S. Jacobus, (extreme right), member of AWS board of awards look on.

facturing Co., Chicago; Second prize, $200.00—jointly by G. S. Mikhalapov, Director of Research, Taylor-Winfield Corp., Warren, Ohio, and G. N. Weygandt, Rensselaer Polytechnic Institute, Troy, N. Y.; Third prize, $100.00—by J. R. Fetcher of E. G. Budd Manufacturing Co., Philadelphia, Pa.; and Fourth prizes, $25.00—by A. M. Unger, Development Engineer, Pullman-Standard Car Manufacturing Co., Chicago, $25.00—jointly by W. B. Kouwenhoven and J. Tampico, both of Johns Hopkins University, Baltimore, Md., $25.00—jointly by M. L. Wood, J. Babin and O. B. Atkin, all with Chase Brass & Copper Co., Waterbury, Conn., and $25.00—jointly by H. B. Axtell and R. L. Ringer, Taylor-Winfield Corp., Warren, Ohio.

Summerill Contest Winners

A new series of awards presented this year for the first time were those of the Summerill Aircraft Contest. These awards included: First prize, $300.00—by Hanford Eckman, Piper Aircraft Corp., Lock, Pa. Second prize, $200.00—by F. H. Stevenson, Vega Airplane Co., Burbank, Cal. Third prize $100.00—was divided equally between F. R. Kostoch, North American Aviation, Inc., Inglewood, Cal., and C. J. Hertel of Douglas Aircraft Co., Inc., Santa Monica, Cal.

In his annual report to the Society, the President, Col. Glen F. Jenks, Ordnance Dept., Washington, D.C., called attention to the recent standards works and the urgently needed work in connection with aircraft standards. He also pointed out that during the past year the Society's membership had increased over 300, giving the Society a total membership of over 4700. The annual budget of the Welding Research Committee was increased to about $140,000 for the coming year.

New AWS Committees

Six new committees were organized to cover: (1) Resistance Welding Standards; (2) Aircraft Resistance Welding Standards; (3) Weldability Tests for Steel; (4) Standard Procedures of Welding; (5) Standards for Welded Joints and (6) Standards for Machinery Construction. The committee on building codes has completed its work on the new "Code for Arc and Gas Welding in Building Construction."

Codes Completed

The technical reports and bulletins which were approved for publication during the year included: (1) Specifications for Welded Highway and Railway Bridges, 1941 Edition; (2) Tentative Standard Qualification Procedure; (3) Recommended Procedure for Welding or Cutting Containers for Combustibles, and (4) Thermal Stresses and Shrinkage in Welded Ship Construction. Two codes were raised from the tentative to a standard status. They were: The A.W.W.A. — A.W.S. Specifications for Elevated Steel, Water Tanks and Pipes and Reservoirs, and Rules for Field Welding of Steel Storage Tanks.

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Highlights of the Highlights

By Welder Wilde

Mr. and Mrs. Jim Gowing, hitchhiking west after failing to get delivery on their new car in Philly, it's a good thing Mrs. Gowing brought along three pairs of shoes—Philadelphia's hotel and restaurant accommodations which were so noticeably lacking during the A.W.S. meeting — Alpha Jewell, *The Welding Engineer's* Brazilian representative, breezing in from Rio—R. D. Thomas and Ted Jefferson dancing a rhumba before a capacity house—the banquet crowd learning the truth about both E. V. David and Miss M. M. Kelly, each an apparent "wolf in sheep's clothing" —The welding training session which seemingly would never end because of the heated but worthwhile discussions—Charlie Davis in his shirt sleeves wishing he could deliver the equipment he was selling—All of the other exhibitors wishing that they could do the same.

Who is the peddler that is afraid to go out at night since he has returned from the Annual Meeting at Philadelphia? According to the way we get the story, he decided to see some of the night life in Philadelphia and deciding that he needed feminine company, picked up a girl while driving on Broad Street. After running through two stop lights he turned to her, saying, "Gee, you must think I'm color blind!" to which she replied, "Ah guess you all is, boss!"

Hanford Eckman, Piper Aircraft Corp., (left) receives the $300.00 first prize in the Summerill aircraft welding contest from J. P. Dods, Summerill Tubing Co., donor of the prize, in the presence of Col. G. F. Jenks.

EUGENE JENNRICH
Supt. T. L. Smith Co.
Milwaukee, Wis.

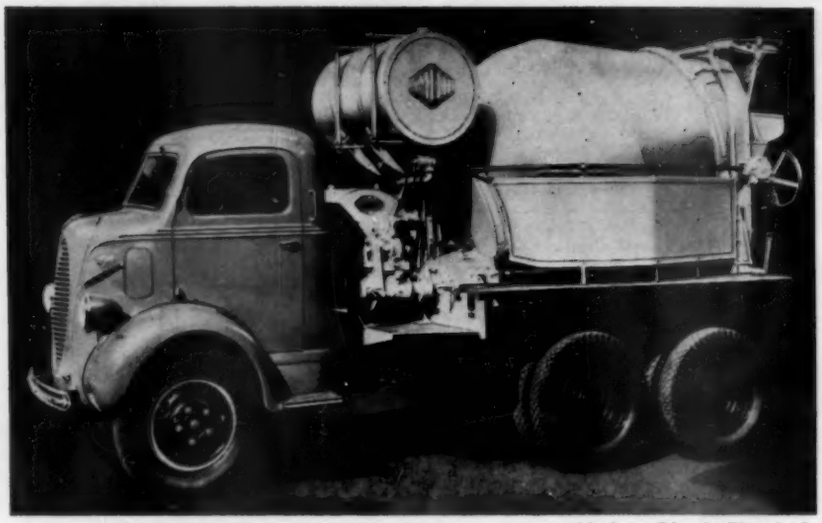

Fig. 1—One of the newest model "Smith-Mobile" truck concrete mixers.

All photos Lincoln Electric Co.

Jigs Simplify Welding

THE manufacture of concrete mixers is far from a production job, even though it may be the sole product of a particular division of a company. Nearly every mixer differs from the previous mixer, even if only from the standpoint of drum capacity.

The manufacture of various size concrete mixers presents many problems but the fabrication of the mixer drum can be greatly simplified by the use of jigs and fixtures. In the T. L. Smith Co. plant a universal jig capable of holding any size drum between 1½ and 4 yd. capacity during tack welding not only simplified fabrication but also had a tendency to reduce manufacturing costs.

Prior to building this welding jig, the welding of mixer drums was not only costly but highly unsatisfactory. This was primarily because the rear spider or cast drum head, the track roller and drip rings are machined before they are welded to the drum. Since they have been machined, it is absolutely required that alignment of all parts be maintained and that the parts be held concentric with the axis of the drum.

Aided by a rather simple fixture such as is shown in Fig. 2 mixer drum construction is easy. By using this jig the building of a drum is merely a matter of stacking parts. First the drum spider is placed on the floor of a jig after which the lower shell is set on the drum spider. This operation is followed by the assembling of the other sections until all of the steel shell has been placed. The jig is now closed by setting in place a cross member which forms the top of the fixture. Once it is set in place, the relative position of all of the drum components is rigidly fixed.

Prior to placing the cross member on the fixture, the roller track is put into position and held there by means of hooks and clamps and the drip ring is hooked in place in the center of the jig cross member. Now a crane raises the cross, holding the roller track and drip ring and as the cross member is lowered over the drum shell, the shell automatically aligns itself with the center axis while stops maintain proper drum height, assuring correct drum length. The cross member is now bolted to the bracket supports which serve as stops on the size of the uprights.

These brackets are fixed at a predetermined height, depending on the size of the drum to be fabricated. By varying the height above the floor of the fixture at which the cross member is bolted to the uprights, it is possible to use this fixture for determining the length of the 1½, 2, 3, and 4 yd. capacity mixer drums.

Upon having assembled all of the

(Continued on page 33)

Fig. 2—Drum spider in place on jig and lower shell being set. (Inset) A 4-yd. drum assembled in jig.

A Dual Purpose Welded Pipe Truss

M. J. RICH
Chief Engineer
Crescent Insulated Wire & Cable Co.
Trenton, N. J.

The use of welded pipe construction greatly simplified the problem of placing a pipeline across a stream. By welded pipe construction the pipe members formed both the bridge structure and the pipeline providing an inexpensive yet highly satisfactory dual purpose structure.

THE operations of a rubber plant are dependent upon a continuous supply of cooling water. Without cooling water the rubber mills and calender rolls would soon become too hot to render satisfactory service.

In our plant an adequate supply of cooling water was located by drilling a deep well but the problem was to get the water to the plant. The well was located about 20 feet from the bank, across a creek from the plant, so the problem was that of getting a pipeline across the stream as directly as possible.

It was decided to install a centrifugal pump at the well and to carry the discharge across the creek in a 4 in. standard pipe.

First consideration was given to a truss constructed of standard steel shapes, principally angles, on which the 4 in. pipe would be supported. The strength was calculated to support the weight of the structure, the pipe full of water, electric cables for current supply to motor and lights, two men, and an assumed load of 500 pounds extra due to possible ice coating during sleet storms. The wood walk is for convenience in crossing the stream to service the pump. Total weight of steel in the riveted structure, pipe and conduit is 3,460 lbs.

A desire to reduce the weight without sacrificing strength led to consideration of the possibility of incorporating the water pipe and conduit as members of the truss, rather than as superimposed load. Internal water pressure will produce tensile stress in the pipe, but when used as the top chord it will be in compression, and so the combined stresses will not be additive. In any case the water pressure used (less than 100 psi) will not produce any serious stress. It is well known that standard pipe is heavier than is necessary to withstand the internal pressure for which it is rated, extra thickness being provided for threading, wrench strains, etc. By welding the joints this extra thickness can be used to provide strength in compression when serving as the top chord of the truss.

It is so used in the new design, the 4 in. pipe forming the top chord and also conveying the water. A 2 in. pipe serves as the bottom chord and also as a conduit to contain one 3-conductor No. 12 cable for lights and sump pump in the pump house at the well. A ½ in. air pipe to serve an ejector for priming the centrifugal pump is supported by the short angle braces.

The round pipe section is most desirable for the truss construction, having a greater radius of gyration than other sections with the same transverse area and clearance dimensions. Therefore, it is the most effective in resisting compression and is equally effective in tension. However, the round members do not lend themselves readily to joining by bolting or riveting. Arc welding permits use of the desirable round members, conveniently joined with great strength, and the top and bottom chords can be used as water pipe and conduit, respectively.

The design adopted and constructed has main members in the vertical plane of standard steel pipes. An auxiliary truss formed of light angles is placed in a horizontal plane to prevent side buckling of the top chord and to provide support for the walk. All joints are welded, not a single bolt or rivet being used at any point.

Fig. 1—The pipe truss pipeline and bridge viewed from the pump side of the stream.

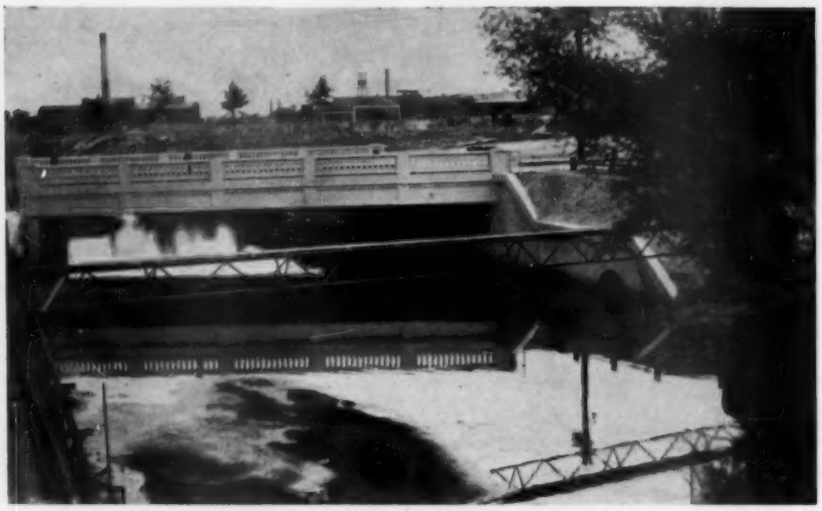

Fig. 2—In this view the pipeline is seen leaving the bridge and continuing alongside the rubber plant.

The 4 in. top chord was butt welded at splices, using 60 deg. "V." The 2 in. bottom chord was butt welded at splices, and four ¼ x 1 bars 4 in. long were welded with ¼ in. fillet welds to provide an extra margin of safety against tension. The 1¼ in. pipe diagonal members were cut to proper angle at each end, but not concaved to suit curvature of top and bottom chords, the openings at sides being filled with electrode material.

The 4 in. pipe selected as necessary to convey the desired quantity of water is not seriously strained as a truss member. At maximum load, including possible ice), the compressive stress is only 4,500 Psi, which should allow ample margin for future corrosion due to its use as a water pipe.

The truss was constructed by a welder and a helper, the two co-operating in placing and welding the members. The top chord was laid on blocks on the ground, brought into line, and the other members erected on it (inverted) as a base, and then the complete assembly was turned to upright position. To avoid using a large number of clamps and to obtain proper alignment, the members were placed, tack welded, and finished a few joints at a time. On this intermittent welding of small joints the progress, measured in feet per hour, was naturally slower than for continuous straight welding, but this was more than offset by the facility with which the assembly could be carried on. The complete truss, except wood walk, was assembled on the ground near the stream and placed in position with a tractor crane.

The accompanying illustrations show the truss after installation. Fig. 1, taken from the south bank of the stream near the pump house, looking diagonally down stream, shows the diagonal members, the cross bracing and part of the auxiliary horizontal truss, the latter being partly covered by the board walk. The upright structure of small angles and wire mesh above the walk is a gate that can be locked to prevent unauthorized access to the plant.

Both ends of the 4 in. pipe, (top chord), are threaded, and at the near (left) end in Fig. 1 the 4 in. line from pump discharge is connected directly to the top chord by means of standard screwed flanges. At the opposite (right) end the top chord is capped with a standard threaded pipe cap, and the water line leading from the truss is welded to the side of the top chord at an angle of about 60 deg. as shown in Figs. 2. A hole was cut with an oxy-acetylene torch and the end of the connecting pipe was torch-cut to the contour of the edge of the hole, then arc welded in place. The compressive stress in the top chord near the ends is much less than in the center of the span, so the metal remaining in the section where the hole is cut is ample for strength.

Table I—Weight of Welded Structure:

Steel members	2,050 lbs.
Welds	30
Wood Walk	450
Water	403
Electric Cables	142
Total	3,075 lbs.

Table II—Ratio

$$\frac{\text{Useful weight (water and cable)}}{\text{Total weight}} = \frac{545}{3075} = 0.177$$

The efficiency of the structure—the ratio of useful weight to total weight — was increased from 0.122 to 0.177, a gain of 45% by using the welded construction.

The figures for the new design show: increase of 45% in efficiency of use; reduction of 1,380 lbs. or 40% in weight of steel; saving of $125.77 or 37% in cost of steel structure.

In addition, due to the rounded, more accessible surfaces the welded structure will be more easily maintained by painting to prevent corrosion, will expose less surface for sleet accumulation, and presents a neater appearance. No attempt has been made to evaluate in dollars these latter advantages, as the figures already presented should abundantly prove the case for arc welding.

THE END

Table III—Cost Welded Structure:

1330 lb. Steel Pipe	@ $ .045	$ 59.85
720 lb. Structural Shapes & Plates	.039	28.08
Assembling, other than actual welding:-		
42 hrs. man & helper	1.30	54.60
Welding (approximately 170 lineal ft.):-		
18 hrs. man & helper	1.30	23.40
40 lb. shielded arc electrode	.12	4.80
Electric power, 150 amp., 25 volts, 40% efficiency, rate .0095 per k.w.h. $\frac{150 \times 25 \times 18 \times 0.0095}{1000 \times 0.40}$ =		1.60
Gas for cutting		1.00
Supervision & overhead (50% of direct labor)		39.00
Total		$212.33

*Data and illustrations from a study submitted to the James F. Lincoln Arc Welding Foundation in a recent program. In its current $200,000 Industrial Progress Program, which closes June 1, 1942, the Foundation is offering 458 awards from $100 to $13,700, for reports of advances and improvements made by application of arc welding in design, manufacture, fabrication, construction and maintenance.

Carefully Controlled Electrode Comparison Tests are Profitable

WALTER J. BROOKING, Testing and Research Dept., R. G. Le Tourneau, Inc., Peoria, Ill.

Part 2—Little testing equipment is required yet valuable information is obtained in comparative burn-off tests of welding electrodes. The proper test procedure is outlined.

Part 1 which was published in the October issue discussed the differences between welds made by different electrodes under the same conditions that can accurately be measured by a watch and a measuring rule. Those tests may be made more complete by certain other preliminary, but extremely important, observations of the electrode in question.*

THE large factory equipped with a research staff may be equipped with tensile testing machines and other special testing equipment, but the small shop or factory is not bound by the lack of such equipment to ignorance regarding the important properties of the metal in its welds. Sensible observations and simple tests which can be made in any shop will yield an abundance of important information on which to make choices of electrodes which are best fitted for that shop's operations.

The first step to be taken is to determine whether or not an electrode is suitable for use in the shop from an operating standpoint. A few electrodes burned by the experienced welder in the shop on some regular production work, or on scrap set up like the regular jobs will quickly tell whether or not the electrodes will function on the machines in that shop without popping out; or whether the electrode will weld the materials in the shop without leaving porosity such as is shown in Fig. 5, or other visible defects which are not left by the electrode already in use; or whether there are other operating factors such as excessively foul or voluminous smoke from the arc, predisposition to undercutting, unfavorable characteristics of slag, or molten crater pool, or other arc characteristics which would require more skill or operator attention to make comparable welds with that electrode in use to which it is being compared.

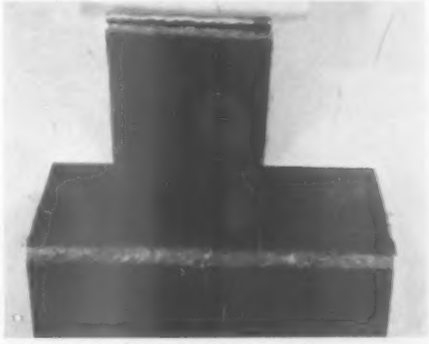

Fig. 6. Some differences in electrodes may be determined by examining the deposited joint. Pores such as these show up in their true importance when the joint is broken. Note how the pore goes through the weld and seriously weakens it.

If the electrode "handles" favorably, the next step is to make several welds on scrap metal similar to typical welds which are made on the job, making some with the new electrode and some with the electrode regularly used in the shop. After these welds have had a chance to cool to room temperature they should be broken and examined. (They must not be broken while hot because they will not have assumed the normal crystalline structure that they will assume on cooling, so will not give a true idea of how the weld will compare with parent metal or what the grain structure of the weld will look like. They must not be cooled by immersing them in water for the same reason).

Much can be learned by comparing these sample welded joints. Figure 6a shows three such welds made by three different electrodes, one having a noticeably flat, rough bead; one smooth and well crowned bead; and one somewhat rough, over crowned weld.

Another simple test which gives important information about these welds deposited by different electrodes is to saw or flame cut and grind a cross section of welded joints such as shown in Fig. 6b. (The same welds as Fig. 6). These sections will indicate the degree of penetration achieved in the weld and also gives a good indication as to the depth of the weld through the throat. An electrode which produces welds which are consistently as flat as bead No. 1 are likely to be a source of failure because the throat is already thin and it is likely that in case of underwelding, which is a normal likelihood in almost any shop at some time. If such

was the case the weld would become only a thin shell.

Etch Examination

If the observer of these preliminary tests is equipped so the sawed and ground cross sections of a weld can be etched with acid, a better idea of the actual weld—its penetration, fusion zone and any small cracks present in it—can be obtained. Fig. 6c shows the ground specimens shown in Fig. 6b after they have been etched in dilute nitric acid (5% in alcohol) for five minutes. Note how the acid etching emphasizes the differences between the welds by showing heat zones, penetration and weld metal to parent metal bond lines. The ordinary small welding shop or factory may not have nitric or hydrochloric acid on hand, but if they really want to see the outline of the weld metal in a ground cross section of a welded joint a small quantity of ordinary dilute sulphuric acid from a storage battery in a glass or porcelain container will serve. The ground cross section can be immersed in this acid solution and left until the weld metal outline can be seen, a matter of only a few minutes. (It should be understood that this acid and method are not satisfactory for fine weld etching, but that it will serve to bring out the outlines of weld metal in a welded joint if no better reagents and equipment are available).

Break Examination

Many things can be learned from breaking such specimens. A sledge hammer, a jack or a press can be used for the purpose, and should be used in such a way as to make the joint break through the weld is possible. If the weld metal is strong enough to break the parent metal of the joint it is a favorable indication as long as the joint is not overwelded. If it does not break in the weld, a partially welded joint should be made and broken. The comparative degree of penetration into the root of the joint and general soundness is evident in a broken weld such as is shown in Fig. 8. The presence of the gas bubbles and worm holes in No. 1, the fewer in No. 2 and the relatively few in No. 3 is caused by differences in the electrodes if the joints and fitup are the same.

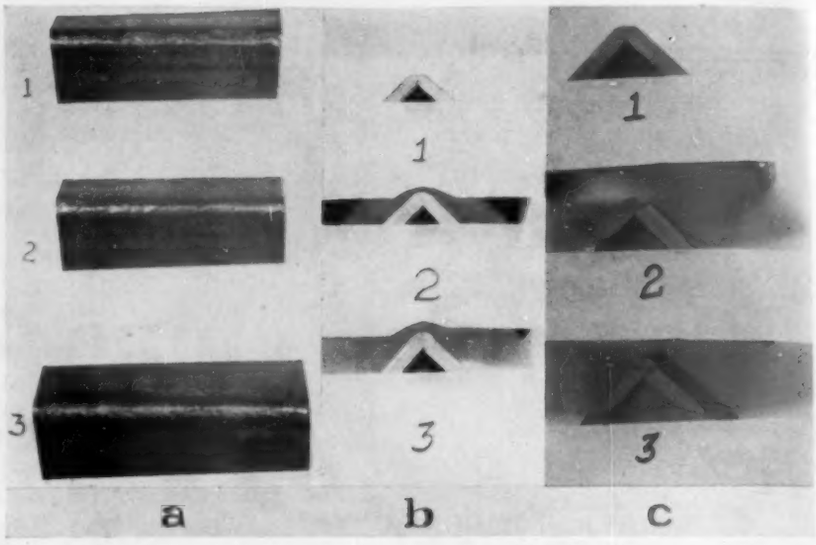

Fig. 6. (a) The differences in appearance, even where no serious defect, such as porosity appears, are important. Note the rough, flat appearance of No. 1, the smooth appearance of No. 2, and the short rippled conventional appearance of No. 3. These are three different electrodes deposited under the same shop conditions. (b) The same welds as seen in (a) are shown from the end after being sawed across the weld. This is an easy way to see and interpret differences. (c) Again we have the same three welds after grinding smooth and etching with 5% nitric acid in alcohol. Note the shallow penetration of No. 1, good penetration and balance of No. 2 and the good penetration of No. 3.

There is little question as to which one of these yields the soundest weld on this particular application. Slag inclusions, or a small line of slag at the bottom of the weld sometimes is found to be associated with one electrode and not another by breaking specimen welds. Grain structures which are coarse, columnar and tend to make brittle, weak welds (No. 3—Fig. 8) are sometimes found in contrast to welds of fine grain structure, which yield before breaking and tear rather than shatter when specimen welds are broken (No. 2—Fig. 8). These differences are important, since they represent characteristics of electrodes which are being tested for the same purpose under conditions which are the same.

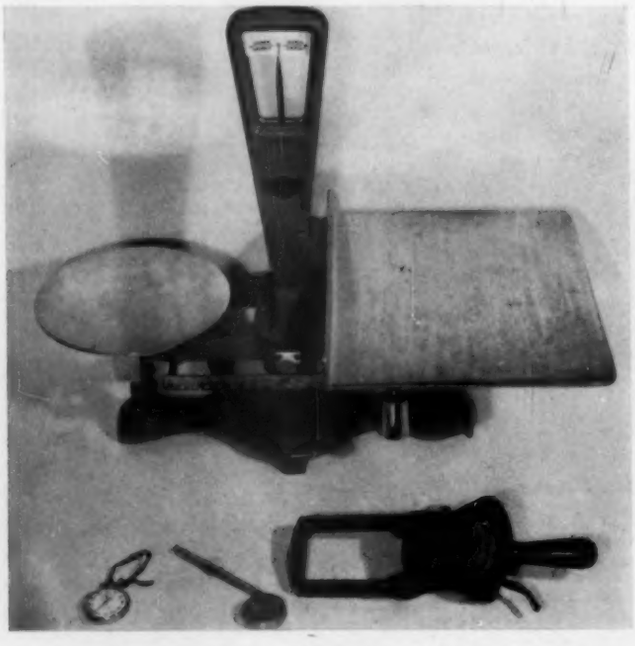

Fig. 7. When more than a few hundred pounds of electrodes are used, the following measuring devices are used. These measuring devices will afford accurate measurements which can show a remarkable difference in the total efficiency between electrodes which seem to be "about the same."

Preliminary Check

The information obtained from the preliminary checking of welding electrodes in the manner described immediately causes the discard of some which may be considered because they are found to be impractical or impossible from the operation standpoint in that particular shop or application.

The objective measurement of burnoff rates, lineal inches of weld per pound and other tests previously described should follow the prelim-

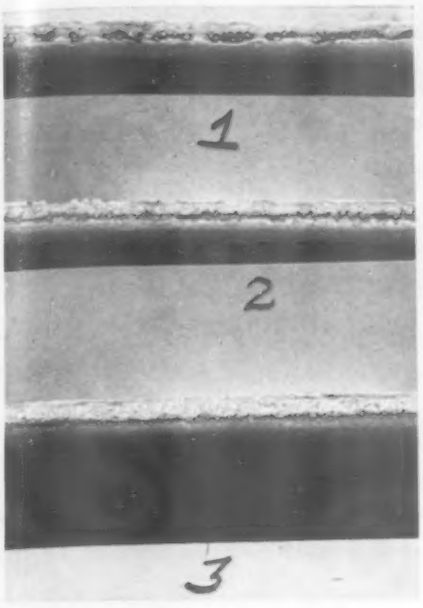

Fig. 8. The same welds as shown in Fig. 6 are now pictured after being broken under a press. Note the porosity, thinness and nonuniformity of No. 1. The jagged breaking, fine grain and also the tendency to bubbles at the root of No. 2; the grainy, coarse and slight tendency of bubbles at the root of No. 3.

inary tests on all electrodes which seem to be satisfactorily from the operation standpoint and whose economy and efficiency may be more favorable than some other electrodes.

A more complete test than the simple comparative timing and measuring described as being accessible to any shop involving only a watch and a measuring rule can be made if an ammeter and a pair of scales such as shown in Fig. 7 are available. With these additional measuring devices a more accurate test can be made in about the same length of time. Any shop which uses several hundred pounds of electrodes a year would find some sort of an ammeter a valuable instrument for checking welding heats and also for use in electrode testing. The scales should have about a 25 lb. capacity, and weigh accurately to a quarter of an ounce.

With the stop watch, measuring scale, weighing scales and ammeter a comparative test can be made which will give an accurate evaluation of an electrode, including the following information:

(1) Burnoff rate;
(2) Percent of electrode actually deposited;
(3) Electricity consumed per pound of deposited metal;
(4) Total cost per pound of deposited metal, including cost of electrode, electricity, and labor (based on burnoff rate);
(5) Number of inches of standard weld per pound of weld metal deposited; and
(6) Cost per inch of standard weld deposited by each electrode sample.

The test for two electrodes can be completed in about 3 hours, and consists of the following steps:

Test Procedure

(A)—*Preliminary*—(1) Get mark for identification, and weigh to nearest ¼ ounce two ⅝ plates 7 x 12 in. in dimension or two plates of similar size and weight for test purposes. These plates will have the electrodes deposited on them.

(2) Obtain twelve representative sample electrodes, weigh eight of these electrodes to the nearest ¼ ounce, measure them to the nearest eighth inch. Keep the other 4 for lineal inches of weld test.

(3) Obtain twelve representative electrodes of stock used in plant regularly, weigh and measure eight as above and keep the other four for lineal inches of weld test.

(B)—*Deposition of metal and timing of burnoff.* Deposit the eight electrodes on the plates, having the same operator use the same welding machine to deposit all of the electrodes. The electrodes should be deposited one of each type on its respective plate and the plates allowed to set idle while the electrode is being deposited on the other plate. Each bead is then cleaned before the next bead is deposited beside it on the plate, and each electrode is burned down to the same length, 1¼ in. for example, in order to be sure that the same relative length of electrode is burned on both samples. This is very important because a very small difference in length of butt will enter a significant difference in the final result.* All butts should be saved and measured, the total length of the eight for each sample should be within ¼ in. of being the same. The arc time is taken with a stop watch for every electrode, starting with the first spark of the arc and stopping with the breaking of the arc at the end of the electrode. Check and record the arc ampere load with the ammeter for each electrode as it is deposited.

If there is a recording killowattmeter available in the plant it is very desirable to attach it to the power line just ahead of the welding machine, and get the total power consumed by machine and electrodes as recorded on the graph shown in Fig. 9. Note that electrode sample No. 2 popped out badly and frequently, thus increasing burnoff time and either requiring more operator attention and skill than No. 1 or leaving inferior welds due to breaks in the arc. The recording killowattmeter leaves an impartial record of power consumption, time, machine idling power consumption and electrode performance.

(C)—*Lineal inches of weld.* Deposit the remaining four electrodes of each sample on a regular production job or scrap setup similar to a regular production job. Be sure that the fitup and other elements of the

*See *The Welding Engineer's* Engineering Data Sheet No. 8 in *The Welding Engineer*, May, 1941.

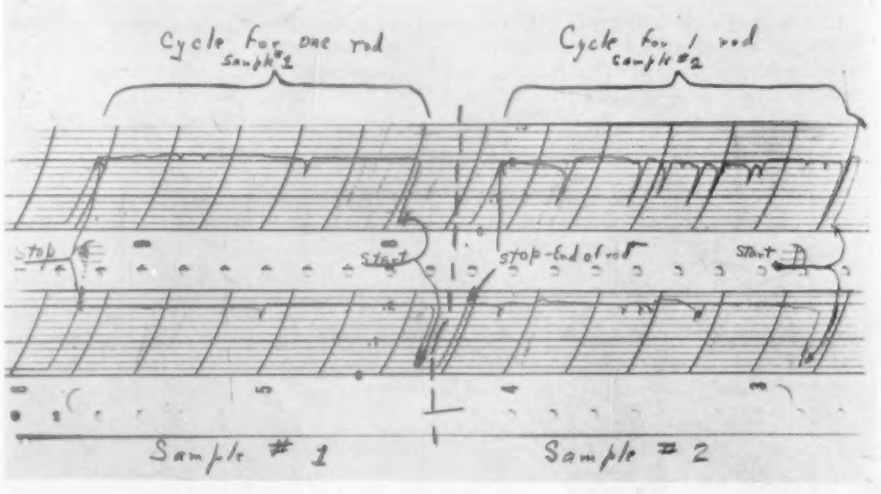

Fig. 9. In shops having recording kilowatt meters, the recording of performance of comparable electrodes is simple. These graphs show that the electrode sample No. 2 popped out badly and frequently, taking a longer time for the burn-off than it should, and of necessity, being harder to handle than sample No. 1 which burned smoothly and regularly. The automatic recording is impartial.

joint are the same, and that all electrodes are burned down to the same length of butt. The operator must deposit the same size of weld with all of the electrodes within the limits of a good uniform production job. By recording the total lineal inches of weld produced from four electrodes of each sample under the same conditions on the same kind of a joint a good comparison of lineal inches of weld per pound of electrode can be obtained. These welds should be a standard weld in the shop or on scrap which can be duplicated at any time in future tests.

(D)—*Measurement after deposition.* (1) Clean all of the slag and spatter drops from welding off the test plates on which the eight electrodes were deposited and weigh each to the nearest quarter ounce. Such a completed and cleaned plate is shown in Fig. 10. The beads could have been closer together and shorter and the test would have been just as effective. There is no object in crowding the ends of the plate.

This concludes the data gathering portion of the test. The third and concluding article of this series will discuss the calculating of electrode, power and labor cost. It will appear in the next issue of *The Welding Engineer*.

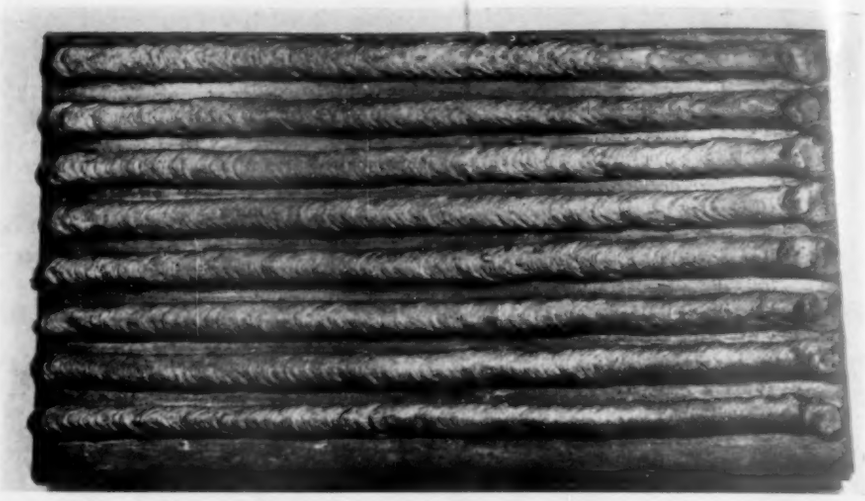

Fig. 10. A weighed test plate with 8 weighed electrodes deposited on it. It has been cleaned of all slag, spatter drops and foreign matter and is now ready to be re-weighed to show how much metal the 8 electrodes totaling a certain weight actually deposited.

Welding and Fan Design

Enhanced appearance and operating improvement were achieved by redesign of fan mountings in the air cooling systems manufactured by Autovent Fan and Blower Division of The Herman Nelson Corp., Chicago, Ill. Formerly this structure comprised flat bar arms bolted to cast iron plate. The new construction was worked out first of all to improve appearance by giving a streamline effect and providing a satisfactory surface for high lacquer finish. A secondary but desirable result is that the round tubing reduces wind resistance and turbulence.

Use is made of this structural feature in the several cooling systems manufactured by the Autovent Division, for commercial, public and industrial buildings; residences; and apartment use. These systems all operate on the principle of providing an adequate amount of air movement for the conditions, with a minimum of noise and power consumption. The fan mounting illustrated in Fig. 1, is typical of the design used in all three systems. The fans and housings are of varying sizes and design to suit the separate conditions for which they are intended.

This mounting utilizes a welded steel tubing, ¾″, 1″ or 1¼″ outside diameter, depending upon the size of the fan, by 0.065-inch wall, bent as shown in the side view, with the tube ends flanged and spot welded to the sheet steel front plate and at the center to the bearing spacer box. The spacer box is cubical in form, being constructed from two steel stampings placed face to face and welded together. The flanged tubes are welded on the flat portions, which gives a very rigid and efficient structure, since the center line of the tube passes through the center of the polyhedral and thus avoids eccentric working stresses at the most important point of load.

In the older construction it was necessary to twist the bar ends ninety degrees to give proper contact for bolting. The tube is more easily bent than the bar stock, and because it is formed from strip of uniform wall thickness the flanged portion offers a uniform thickness which gives consistent results under a regulated spot welding technique. The tubular structure is lighter (¾″ O.D. x .065″ tube weighs .48 lb. per foot; 1″ O.D. x .065″ tube, .65 lb.; 1¼″ O.D. x .065″ tube, .82 lb.). Round tube also has a higher torsional value and reduces vibration, which is a big factor in this type of equipment. The reduced weight of welded tubular construction not only saves essential material but also reduces shipping expense.

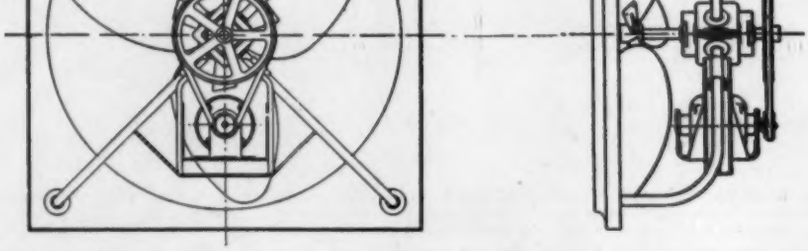

Fig. 1. Plan and elevation of redesigned fan.

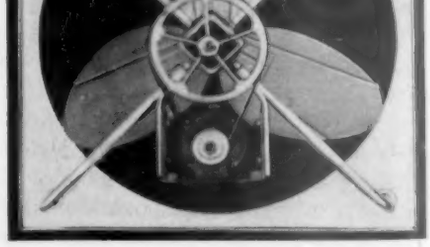

Fig. 2. The finished product.

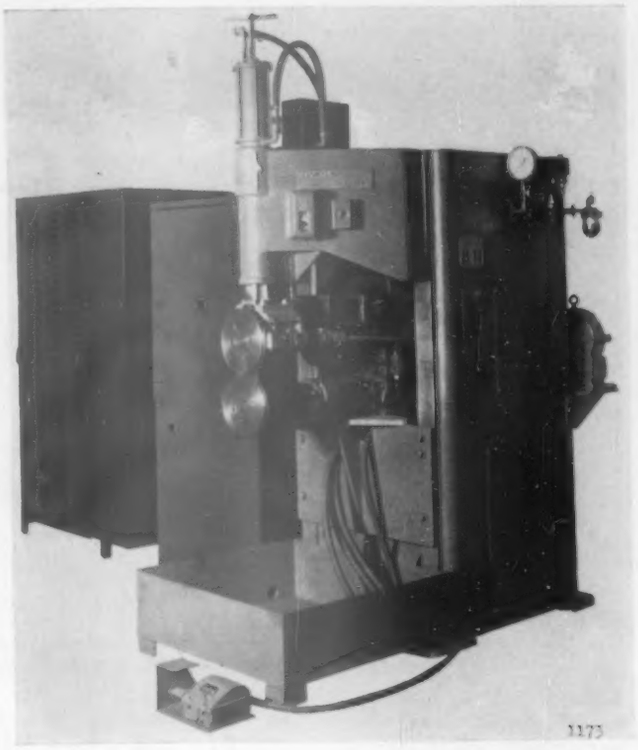

Fig. 1—A series capacitor (left) connected with a modern seam welder.

R. E. MARBURY* on

How to Determine Series Capacitor Requirements of Resistance Welders

The increasing use of resistance welding in the assembly of aluminum parts calls for capacitors. By a few simple formulae it is possible to calculate capacitor requirements.

It is now recognized that capacitors can be used with resistance welders which will result in the reducing of the instantaneous KVA load demand from 50 to 75 percent. Or if heavier weld currents are required, the use of capacitors will permit the operation of a resistance welding machine more than double in size from a given power circuit. This reduction in KVA demand will eliminate lamp flicker in most cases and remove restrictions often imposed by the utility on the operation of resistance welders. Larger welds can be made on a given power supply, and the power factor of the welding machine may be made as good as the lighting loads. Poor welds caused by interference between welders are likewise eliminated because the voltage dips are eliminated.

Applying capacitor to resistance welders is not as simple as applying shunt capacitor to a plant circuit. In the case of shunt capacitor, the voltage is fixed. Their kva needed is known by the load so a capacitor is needed which has this KVA rating and a voltage rating corresponding to the circuit voltage. A shunt capacitor is as independent of the load as one load is from another, and it can be operated with less, more, or no load.

The capacitor to be used with a resistance welding machine must be of the series type. There is shown the general arrangement of a capacitor and welder in Fig. 1.

In the case of the series capacitor, the voltage of the capacitor is not determined by the line voltage but by the design of the welding machine. In fact, the reactive component of the welder is the determining factor.

The combination of series capacitor plus welding machine must operate from the same line voltage in the usual installation; therefore the welder must be rewound for a higher voltage. The two must be treated now as one machine so it is obvious that each welder must have its own series capacitor.

A wiring diagram showing the electrical arrangement of the parts when capacitors are used with a resistance welding machine to reduce peak KVA loads is given in Fig. 2.

The series capacitor proper consists of a number of 15 KVA units with individual fuses. A relay is provided to trip the main supply if sustained overvoltage occurs on the ca-

*Switch Gear Engineering Dept. Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

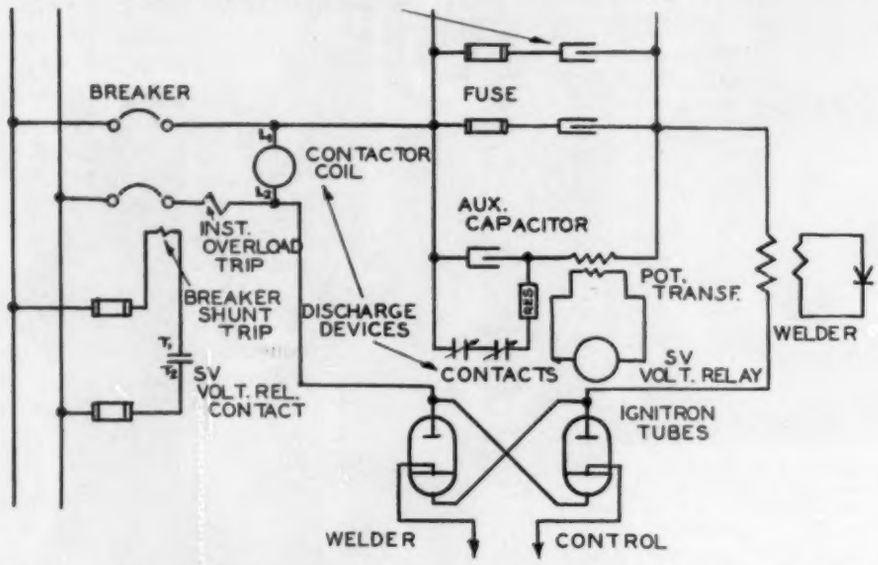

Fig. 2—A wiring diagram for a resistance welder indicating the arrangement of electrical equipment when a capacitor is in the circuit.

pacitor due to shorted electrodes. A blocking or auxiliary capacitor is inserted in the voltage transformer operating the relay so that the latter will not discharge the capacitor between welds. A no voltage coil releases contacts to short out this auxiliary capacitor so that the potential transformers will discharge the capacitor when the supply breaker is opened.

Power Demands

The welder is usually operated or controlled by ignitron tubes or the equivalent. The data furnished may or may not include the drop in these tubes. If the KVA demand and power factor includes the drop in the tube, the value of capacitor voltage and the voltage for rewinding the welder may be computed as follows:

The first step is to determine the KW power demand at unity power factor from product of KVA and power factor (KVA measured during weld):

$$KW = KVA \times PF$$

next the load current at unity power factor may be obtained by dividing KW by line voltage:

$$I = \frac{KW \times 10^3}{E_1}$$

and voltage E_3 by dividing load KVA by load current I:

$$E_3 = \frac{KVA \times 10^3}{I}$$

The resistance and reactance of combination of welder plus tubes is now sought looking into the primary under load conditions when wound for terminal voltage E_2 using the formula

$$R_c = \frac{E^2 \times \text{Load PF}}{\text{Load KVA} \times 10^3}$$

Assuming a 15 volts drop across the tubes, the welder terminal voltage E_2 can be determined since $E_2 - E_3 = 15$.

Then the tube resistance is

$$R_t = \frac{E_4}{I}$$

while the Resistance of Welder is

$$R_w = R_c - R_t$$

and Welder Reactance is

$$X_L = \sqrt{\left(\frac{(E^3)^2}{\text{Load KVA} \times 10^3}\right)^2 - (R_c)^2}$$

The reactance of the capacitor must equal welder reactance for 100 per cent power factor. The microfarad capacity of capacitor can be determined from the capacitor reactance ohms X_c when the capacitor working voltage during welding is IX_c by the following formula:

$$C = \frac{1}{(2\pi f)(X_c)\ 10 = 6}$$

for greater ease in calculating the microfarad capacity this formula may be changed to read

$$C = \frac{1{,}000{,}000}{(2\pi f)(X_c)}$$

The resistance and reactance of the combination of welder plus tubes should now be determined looking into the primary circuit under shorted electrode conditions when the welder is wound for terminal voltage E_2 calculated for load condition. In these calculations the value of KVA used and the power factor are those obtained by tests with the electrodes of the welding machine shorted.)

Under these conditions

$$R_c = \frac{(E_3)^2(PF)}{KVA \times 10^3}$$ again

Assuming 15 volts drop on tube E_4, the welder terminal voltage $E_2 = E_3 - 15$.

Welder Reactance now becomes

$$X_L = \sqrt{\left(\frac{(E^3)^2}{KVA \times 10^3}\right)^2 - (R_c)^2}$$

The total impedance presented to line when electrodes are short circuited is found by use of the formula

$$Z = \sqrt{(R_c)^2 + (X_c - X_L)^2}$$

after which can be determined the short circuit current:

$$I_{sc} = \frac{E_1}{Z}$$

where 2 is overall impedance. The voltage on the capacitor during the time when the electrodes are accidentally shorted is therefore IX_c = Capacitor Voltage E_5 = Voltage with electrodes shorted, when I is the current flowing with electrodes shorted.

Capacitor Specifications

The above makes it possible to supply the capacitor manufacturer with the following specifications.

(1) The capacitor reactance ohms X_c or the microfarad value

(2) The capacitor Voltage E_5

(a) During weld

(b) When electrodes are short circuited

Where KVA demand and power factor figures given do not include the drop in the ignitron tubes, the KW power demand at unity power factor is determined from product of KVA and power factor (omitting the tube), or as follows:

$$KW = KVA \times PF$$

Having obtained the KW power demand, it is now possible to determine the load current at unity power factor by the formula

$$I = \frac{KW \times 10^3}{E_1 - E_4}$$

With this information voltage E_2 is

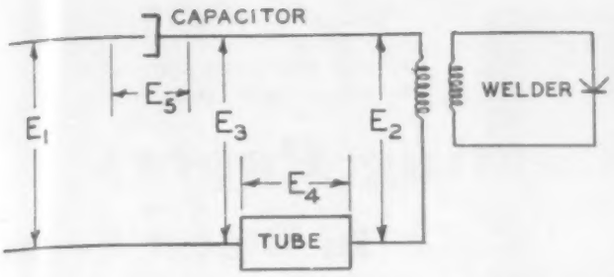

Fig. 3—A schematic diagram of a resistance welder wiring circuit indicating where voltage drop readings are obtained.

determined by

$$E_2 = \frac{KVA \times 10^3}{I}$$

Now sufficient information is at hand to determine resistance and reactance of welder by looking into the primary circuit under load condition when the welder is wound for terminal voltage of E_2

$$R_W = \frac{E_2 \times \text{Load PF}}{\text{Load KVA} \times 10^3}$$

Welder Reactance now becomes

$$X_L = \sqrt{\left(\frac{(E_2)^2}{\text{Load KVA} \times 10^3}\right)^2 - (R_W)^2}$$

The X_L ohms indicate capacitor ohms X_C because they should be made equal for unity power factor for the most desirable condition. It is assumed that the capacity working voltage is IX_C when I is the current during the welding operation.

Circuit with Electrode Shorted

Now to determine the resistance and reactance of the welder by investigating the primary circuit under shorted electrode conditions when the welder is wound for terminal voltage E_2 calculated for load conditions.

The short circuit kva and power factor when the electrodes are shorted must be used in these calculations. By substituting these conditions in the formulae it is now found that:

$$R_W = \frac{E^2 \times PF}{KVA \times 10^3}$$

and that

$$X_L = \sqrt{\left(\frac{(E_2)^2}{KVA \times 10^3}\right)^2 - (R_W)^2}$$

The total impedance presented to the line is then obtained from the following formula:

$$Z = \sqrt{(R_W)^2 \times (X_C - X_L)^2}$$

which by substitution becomes

$$I = \frac{E_1 - E_4}{Z}$$

Having thus determined the capacity ohms and current both under welding and short circuit conditions, it is next desirable to determine the duty cycle. Out of the total time, what percentage of the time is current flowing? If the duty cycle is less than 44 per cent the capacitors may be chosen so that during the actual welding period they may be subjected to a voltage which exceeds that at which the capacitors would be rated for continuous use. The duty cycle, therefore, enters into the cost of the capacitor for a given X_C ohms, and a given welding current.

Sometimes the voltage E_5 during short circuit conditions is so great that even though it is of short duration and rare in occurence it nevertheless determines the size and cost of the capacitor rather than the current during welding.

Glossary

E_1 = Supply voltage.
E_2 = Voltage across terminals of the welding machine or transformer.
E_3 = Voltage across the welding machine terminals, plus voltage drop across tube when used.
E_4 = Voltage drop across the tube.
E_5 = Voltage drop across series capacitor.
R_c = Resistance of welder plus tube.
R_t = Resistance of tube.
R_w = Resistance of welder (not shorted).
X_L = Reactance of welder (not shorted).
X_c = Reactance of capacitor.
Z = Impedance.
I_{sc} = Maximum short circuit current (electrodes shorted).
I = Load current.
F = Frequency in cycles.
C = Microfarad capacity.

Jigs Simplify Welding

(Concluded from page 24)

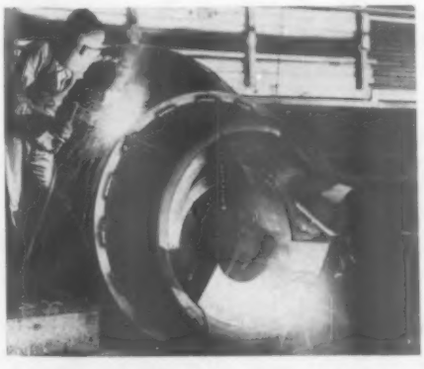

Fig. 3—Rotating jig facilitates welding of concrete mixer drum.

various pieces comprising the mixer drum, the sheet steel and castings of the assembly are ready for tack welding. After tack welding, the hooks and clamps of the cross member are removed. The drum is now ready for removal and positioning in a rotating jig, such as may be seen in Fig. 3, for the completion of the welding. Like the assembly jig, all of the rotating jigs are adjustable to accommodate the various size drums manufactured.

Another welded fixture that has been found very useful about the shop is one which was made for handling the mixer units during manufacture. This fixture must be sturdy enough to handle mixer units weighing up to 8500 lbs., yet at the same time be light enough to be practical. Before this welded lifting unit was designed, it was necessary to use 5 men, several heavy I-beams and two sets of chain blocks to handle each unit. An expensive and hazardous operation.

The lifting unit, which is made of welded construction, consists of 5½ in. pipes welded to form a square frame and is provided with cables for hook attachments. Both the hooks and the cables may be adjusted by sliding the cables along the pipe frame to meet the requirements of the various size mixing units. The advantage of such a flexible unit may be seen in Fig. 4 where it is pictured lifting an assembled mixer for mounting on a truck. Note how the mixing unit is held level at all times.

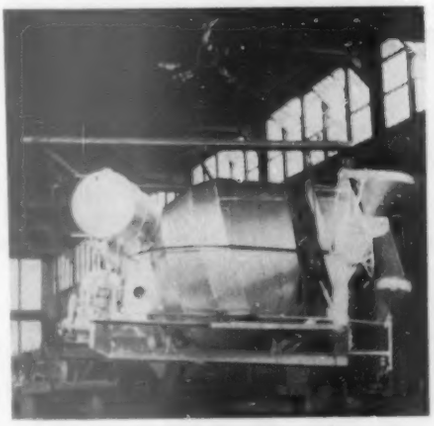

Fig. 4—Concrete mixer unit in arc welded lifting hook, which does the work of five men.

Some of the A.W.S. Annual Meeting Papers in Digest Form

A variety of technical papers were presented at the 22nd Annual Meeting of the Society in Philadelphia. Many of the 63 papers presented are reviewed in this summary.

Uses of Flame Hardening in Machine Tool Production

By A. L. HARTLEY*

★ This paper points out the complete absence of technical data on flame hardening of general purpose parts of the types encountered in machine tool production. It briefly outlines how this absence of data has caused many companies to avoid the adoption of this process of hardening.

Some of the many problems encountered in establishing standardized data are outlined and carefully considered. The establishment of standards for flame hardening of flat cast iron bars is considered in detail. Operating curves for hardening both cast iron and steel by the Progressive Method are shown and discussed. The advantages of these curves for plants which produce a wide variety of parts in small quantities is emphasized.

It is shown that not only uniform penetration of hardness but microstructures which are equally as good as those produced by furnace hardening can be readily obtained by operating in accordance with carefully standardized conditions. It is pointed out that to date there is no commercial equipment available for measuring the surface temperature of a part while it is being flame hardened. However, it is stated that when a flame hardened and furnace hardened specimen of the same material have identical microstructures the temperature from which the furnace hardened specimen was quenched can be considered the effective temperature of the flame hardened specimen. It is stated that if operating conditions are established which will produce satisfactory microstructures the actual determination of the surface temperature of the metal during the flame hardening operation is not absolutely essential.

The factors which produce distortion are carefully analyzed. The magnitude of the internal stresses which cause this distortion are mentioned. The effect of strain relieving on the magnitude of these forces is given very careful consideration. The disadvantages of the various common methods of preventing distortion such as prebowing, clamping in bowed position during the flame hardening operation are outlined.

The advantages of flame strain balancing are carefully considered. A typical application of a commercial machine tool part which is regularly hardened and strain balanced on a production basis to close straightness tolerances is used as an illustrative example.

The internal stresses which are set up by flame hardening and strain balancing are compared to those set up when parts are carburized and hardened.

A brief period is devoted to the description of a universal flame hardening machine. The unit which is described is designed to flame harden parts by the Progressive Method, the Spinning Method or the Combination Spinning and Progressive Method. It has a capacity of hardening surfaces up to 20 in. wide x 20 ft. long. Parts up to 33 in. in width or diameter can be set in the machine. The details of this unit are clearly shown by illustrations. It is probably the largest universal flame hardening machine used in regular production at this time.

Numerous typical applications of flame hardening operations are illustrated and discussed. In this discussion the hardening of wide surfaces by the Progressive Method is illustrated. The problems of hardening two adjacent surfaces simultaneously and in separate operations are given consideration. Gear hardening operations by both the Progressive and Spinning Method are illustrated as well as numerous other problems encountered by machine tool builders.

Several special burners were shown and discussed.

The paper clearly shows the present and potential value of this comparatively new method of hardening and points out that with further research and development this comparatively new method of heat treating should become a major operation in the machine tool industry.

*Metallurgist, R. K. Le Bland Machine Tool Co.

The Shotweld Process of Welding Stainless Steel "18-8"

By JOSEPH WINLOCK[1] and JOHN J. MacKINNEY[2]

★ The purpose of this paper is to show how the problems connected with resistance welding are dependent not only upon proper welding technique but also upon the metallurgy of the metal or alloy being welded. The metallurgy of stainless steel "18-8" is briefly described from this point of view and a description is given of the methods which were employed in establishing the proper welding conditions for this metal.

An Investigation of Welded Connections for Angle Tension Members

By G. J. GIBSON* and B. T. WAKE*

★ The designing and detailing of welded structures with angle members are often handicapped by a conventional practice of connecting such members with "balanced" welds. This practice consists of distributing the welds along the heel and toe of the angle so that the working strengths of the welds are balanced about the center of gravity of the angle. The purpose of this investigation is to determine whether it is necessary to adhere to this practice of balanced design or whether other arrangements of welds are equally effective.

Tensile tests were made with specimens having single and double angles connected to flat plates to determine the strength of various arrangements of welds commonly used for angle connections. The size of the angle used for all tests was 2½x2½x$\frac{5}{16}$ in., and the welds were designed so that the test specimens would fail in the connection rather than in the angle. Special measurements were taken on a few typical specimens to determine the deflection and stress distribution of the angles particularly in the single angle test specimens.

Single angle connections are eccentric with the application of the load and their

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*American Bridge Company.

tests are characterized by bending of the angle in a direction normal to the plane of the welds. This bending action has a considerable influence on the strengths of the various connections. The stress measurements of the single angles showed that at the working load a portion of the outstanding leg of the angles was not effective in tension. The double angle tests showed very little bending of angles and the strengths were higher and more uniform than single angle tests of the same connections.

The non-uniform stress distribution in a single angle tension member, which results from having only one leg of the angle connected, makes the basic theory of a balanced design inapplicable. At the working load of the angle a portion of its outstanding leg is not effective in tension, and at the ultimate load the stress distribution is such that the angle will fail before is full tensile strength is reached. Unbalanced arrangements of the welds are as strong as balanced connections for either single or double angle members. The results of these tests show that there is no necessity or justification for using a "balanced" design of welds for angle tension members.

Surface Polish and Contact Resistance

By W. B. KOUWENHOVEN[1], and J. TAMPICO[2]

★ The authors have continued their study of the effect of the degree of surface finish on the contact resistance of 25 point cold rolled carbon steel. The results are reported for specimens with rough surfaces and for those with highly polished, mirror-like, smooth surfaces. The variation in contact resistance with pressure and current was measured under equilibrium conditions of temperature.

The contact resistance of the rough surfaced specimens, which had been polished with 2/0 emery cloth, was of the order of several micro-ohms per square inch and their resistance decreased relatively little with either increasing pressure or current density. We were surprised to find that at low current densities the contact resistance of the smooth surfaced specimens reached values of nearly two hundred micro-ohms per square inch of contact area and that increasing the pressure had little effect on the resistance. An increase in the current density had, however, a very marked effect on the contact resistance of the smooth surfaced specimens. Measurements showed that at current values of the order of 2500 to 3000 amp psi the resistance fell to less than one micro-ohm even at low values of pressure.

The results clearly indicate the presence of films of either absorbed gases or oxides on freshly cleaned steel surfaces and their effect on the contact resistance. The paper closes with a discussion of the possible applications of the data to welding practice.

[1]Prof. of Elec. Eng., School of Eng.
[2]Dr. Eng., Johns Hopkins University.

Photo Hobart Bros. Co.

Production capacity can be doubled by using two welders on different parts of the same assembly.

Evaluating Welded Joints

By W. F. HESS*

★ This paper discusses the purposes and methods of making weldability tests. It describes a series of tests which are believed to furnish a complete picture of the satisfactoriness of welded joints from the standpoint of physical properties of the weld, the relation between these and the properties of the base metal, and the production of cracks during welding. The effect of residual stress and of chemical changes which take place during welding, on the yield strength of weld metal are considered. Attention is called to the importance of welding conditions in relation to the improvement of properties by stress relieving. Important differences in the quality of weld metal are shown to result from differences in welding technique. A method of simplifying the process of determining satisfactory welding conditions for a wide variety of medium carbon and low alloy steels is suggested.

It is concluded that the weldability test described in the paper, consisting of a series of three specimens, in conjunction with actual measurements of cooling rate associated with the welding of these specimens, should make possible an important simplification in the proper application of welding to a wide variety of steels. The ability of these tests to establish limiting welding conditions to be used with and without stress relief, as well as limiting conditions for various ambient temperatures, is emphasized.

Welding Aluminum-Containing Steels

By C. E. SIMS[1] and F. B. DAHLE[2]

★ Results obtained in a study of welds made on SAE 1020 steels containing small amounts of aluminum are presented. The objective was the determination of fundamental effects produced by the aluminum content in the welded section.

Inasmuch as other investigators and some preliminary work had shown that aluminum had the most pronounced effect on the porosity in the weld, this factor was given special attention in the work.

It is shown in the data that test welds made with mineral-coated electrodes were unaffected by metallic aluminum contents in the steel up to at least .20%. Practically no porosity was observed in the radiographs of welds regardless of the technique used in making the multiple-pass deposits. The use of cellulose-coated electrodes on the other hand, produced data which indicated that welding technique was a factor which was much more important than the aluminum content in its influence on porosity. It is shown in the paper that the porosity of the weld metal shows a decided increase when a multiple-layer or weaving technique is used in filling in scarfed grooves. This condition is characteristic only of the cellulose-coated electrodes and is not a function of the aluminum content. Test data are given to show that a minimum of porosity may be obtained in multiple-pass welds of aluminum-containing steels if certain minor precautions are observed.

A few data are also given to illustrate the effect of hydrogen in welds of steels containing small amounts of aluminum. The data indicate that welds of steels containing aluminum are not any more susceptible to hydrogen embrittlement than are aluminum-free steels.

Electrical Measurement of Electrode Pressure During Spot Welding

By W. F. HESS[1] and L. D. RUNKLE[2]

★ This paper is a report of studies of friction and inertia in welding machines made with the electrical pressure gage. Recommendations are made for investigations which will require the accurate measurement of electrode travel as well. Quantitative studies of the effects of

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[2]Research Fellow, Department of Metallurgical Engineering, Rensselaer Polytechnic Institute, Troy, New York.

Welding makes streamlined water towers possible.

various amounts of friction have been made, and both experimental evidence and mathematical analysis have shown the importance of the directional effect of friction. It is indicated by theory and from the records, that friction which acts to reduce the electrode pressure really is a desirable element. Inertia in welding machines is discussed, and suggestions made as to its desirability for extremely short time welds. The usefulness of the electrical pressure gage to designers and manufacturers is the ability to record the current and pressure simultaneously.

It is concluded that the proper type of friction is desirable because it permits the production of sound welds at lower currents gives wider range of line voltage fluctuation for satisfactory welds, and permits expulsion of metal during welding without objectionable loss of pressure. The electrical pressure gage is of assistance to the manufacturer in the development of a satisfactory pressure cycle.

Training Brazing Instructors For National Defense

By LEO EDELSON*

★ The United States Navy, after many years of laboratory development and field experience in conjunction with manufacturers of valves and fittings and a manufacture of silver brazing alloy, selected an insert type of fitting as a standard for joining all non-ferrous pipe.

This decision outmoded the use of screw threads and created a condition where men who had been doing this type of work in the past were forced to learn new methods. Suitable training facilities had ben set up by the interested manufacturers working in cooperation with the Navy Department to help train and qualify men in this new piping practice. Due to the advent of the tremendous expansion in the Naval program, these facilities proved inadequate.

To correct this situation, the Walworth Co., Air Reduction Sales Co., and Handy & Harman, with the cooperation of the Navy Department, developed a so-called Student-Teacher Course and two schools, one on the East coast and one on the West coast, were opened. The Student-Teachers complimented the number of men available for this activity and we are now in a position to train new men in the quantities necessary and also those men who previously did this work in the yards under the old methods.

The function of this paper is not only to act as a review and a guide to those Student-Teachers who have graduated but it is also the author's sincere desire that a review of this paper by manufacturers with like problems may take advantage of this ground work and also cooperate with the Navy to the end that our ships shall be built properly, safely, and rapidly.

*Div. Engr., Handy & Harman.

Methods of Testing Spot Welds

By R. E. BOWMAN*

★ The policy of the Material Division in regard to the inspection of spot welds is outlined and discussed. The results to be obtained are specified rather than the equipment or procedure used to obtain the results. The inspection of spot welds is accomplished by tests on single spot lap welds and by radiographic and metallographic examination. Requirements have been established for the strength of the single spot lap weld and also for the soundness of the spot weld. There are no definite requirements regarding the equipment and procedure provided that spot welds are produced which will consistently meet the requirements for strength and soundness.

The tests used by the Material Division to determine the ductility and the tests to determine the resistance to corrosion and fatigue are described.

The twist test and the U tension test have been useful in determining the relative ductility of spot welds in different alloys. In the tests of spot welds in aluminum alloys some degree of correlation was found between the twist test and the U tension test. The ductility can be determined only approximately with these tests. In the twist test the failure does not always occur in the weld metal. In some tests the failure will occur in the base metal surrounding the spot weld. The result in the U tension test is affected by the amount of bending which occurs when the spot weld is tested.

The corrosion resistance of the spot welds is compared by exposing spot welded panels on the racks in the tidewater near Miami, Florida. In this test the panels are alternately immersed in the salt water during the high tides and exposed to the atmosphere during the low tides. The length of exposure is usually from 6 months to one year. After exposure the spot welds are examined visually or tested to determine the loss in strength.

The results of tests on spot welded fatigue specimens are not considered satisfactory since they did not furnish any information regarding the extent to which spot welding can be used in aircraft. The most successful procedure has been to conduct static, vibration, and service tests on spot welded parts of airplanes.

*Asst. Elec. Engr., War Department, Air Corps.

Magnetic Arc Blow

By CHAS. H. JENNINGS* and ALFRED B. WHITE*

★ Magnetic forces producing arc blow are measured by means of a magnetic balance and test data regarding the relative magnitude and direction of these forces under various conditions are given. Eddy currents are shown to be responsible for the reduced arc blow normally obtained with a-c welding.

Rules are given for determining the direction of arc blow and for reducing the magnitude of arc blow by means of welding procedure, magnetic shunts, tack welds, etc.

*Research Engineers, Westinghouse Electric & Mfg. Co.

Welding Application in Naval Machinery

By HUGO W. HIEMKE[1] and JOHN D. BERT[2]

★ The machinery installed on Naval vessels has to be designed to meet a combination of service requirements which challenges the ingenuity of its builders. The primary concern is to build machinery which is reliable in its operation. The failure of even a n' .or part of the machinery plant durii.g a Naval engagement might mean the difference between victory and defeat. Superimposed on this requirement of unquestioned reliability are weight and space limitations, the ability to resist explosive shock, and operation in an inclined position, all of which are peculiar to the needs of Naval shipbuilding. The economy factor is represented by a desire to have as large a cruising radius as possible, after all the other required conditions are satisfied.

It is no wonder that marine engineers were conservative in their application of welding to ships' machinery. First it was necessary to prove that welding could contribute something to the reliability of operation, or otherwise, that it produced equal reliability compared to the fabrication methods it sought to replace, and at the same time made it possible to decrease the size and weight of the machinery.

Painstaking research preceded all of the applications of welding on shipboard. Until it could be demonstrated that welding was capable of producing reliable joints, having both the strength and the toughness of the metal being joined, shipboard applications of welding were unimportant. After the basic physical properties were known, addi-

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tional testing was done to be certain that welding was entirely satisfactory for a particular application.

It is interesting to note that welding was not widely used before 1930. The development of covered electrodes made the difference between acceptance and rejection of the method. Until 1930, the application of electric arc welding was drastically limited because of the relatively low ductility obtainable with bare and lightly coated electrodes. It was only after the development of covered electrodes made it practicable to produce sound welds in heavy plate with both the strength and the ductility of the plate itself that responsible engineers were willing to accept welded boilers. This same criterion influenced the acceptance of welding for many other important engineering applications. After ductile weld metal was available, it remained only for the ingenuity of the design engineer to apply welding properly—to utilize welding in the solution of their problems—and its acceptance was practically assured. Some developments seemed slow in coming, but, in retrospect, the truly remarkable thing is the rapidity with which time-honored fabricating methods were either replaced or evolved to utilize welding. In less than 10 years, we have gone from the phrase "no welding will be permitted" to "consideration will be given to the use of welding," and now, "welded construction shall be used." Machinery units on which welding is not now used are few indeed.

Each service application, such as boiler drums, super-heater headers, boiler casings and stacks, high pressure piping, piping systems of copper and its alloys, disks and seats of high pressure valves, high pressure turbine casings, low pressure turbine casings, gears and gear casings, diesel engine frames, heat transfer equipment and electrical machinery, involves special problems and an effort will be made to present some of these problems, the means by which these problems were solved and the special fabricating and inspection requirements which are currently used on various types of machinery to control the quality of the welding.

Welding has replaced riveting in boiler drum construction because stress-free, pressure-tight drums could be readily produced. Welding has replaced numerous castings such as cast gears, gear-cases, and low pressure turbine castings, because of great possibilities for weight saving. Composite cast-welded construction has replaced single piece steel castings in high pressure turbine casings and pipe manifolds to overcome leaks frequently encountered in steam pressure castings. Welding has been used in steam piping to eliminate flanged joints, and silver brazing has been used to eliminate threaded fittings in low pressure piping systems.

Qualified welders and approved electrodes are required for all machinery welding, but other tests and safeguards are required for certain classes of work, depending on the hazards of the service. Thus the welding of boilers, turbines and steam piping require process approval tests and radiographic inspection. Stress relieving is also required for most machinery welding with the exception of low pressure piping and pressure vessels.

Infrared Photography of Fusion Welds

By WILLIAM T. TIFFIN*

★ Fusion welding, as a method for joining metals and alloys, has greatly increased its field of application within a comparatively short and recent period. Such increased application inquires improved methods of inspection and control in order that acceptable standards of quality and of excellence in the actual welds will be assured.

Thus far photographs made with white light as the source of illumination have been considered sufficient to serve as permanent visual records of the actual structure of the cross-sections of weld specimens. Such photographs show excellent detail, illustrate features which had been previously emphasized by acid etching of the specimen, and are comparatively economical and easy to produce. The success which infrared photography has had in the medical and other scientific fields led to its consideration as a method for securing improvement in the photography of weld specimens.

This paper reports upon an investigation of infrared photography applied to the examination of fusion weld specimens, discusses a successful technique, and illustrates the following advantages: greater contrast between weld metal and metal adjacent to the weld; better definition of the zones within and adjacent to the weld that are affected structurally and chemically by the heat of welding; and a clearer definition of the outlines and extent of defects and impurities. Further applications of infrared photography in this particular field are also indicated.

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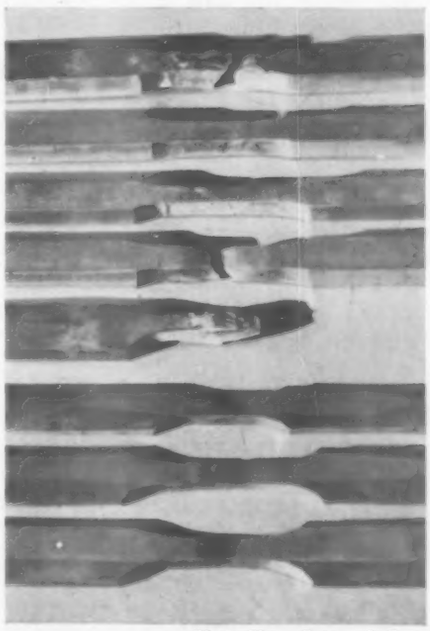

Photo Chase Copper & Brass

Typical tensile test specimens of Red Brass pipe welds and plate welds.

Welding of Copper

By A. P. YOUNG*

★ This article is the third to be written on the results which have been obtained from research on the Welding of Copper at the Michigan College of Mining and Technology. Previous articles dealt with the welding on plates less than 0.375 and on plates 0.501 in. thick. The results presented here are from welds on 0.375 in., 0.435 in. and 0.501 in. plate.

During 1941 sixteen welds were completed, cut into coupons, tested, and the results therefrom computed. The method of preparing the plates before welding, procedure during welding, and the testing of the coupons are all discussed in the first part of the article. Information obtained from the investigation of preheating, the variation of the voltage and amperes, and the use of two different filler rods and vee angles are presented in the body of the article. Photographs and tables are used to illustrate the points discussed and the results obtained. The final section of the article is given over to a summary of the effect of power variation, preheating, the vee angle, and other factors upon the resulting weld.

The Spot Welding of Nickel, Monel and Inconel

By W. F. HESS[1] and A. MULLER[2]

★ The investigation reported in this paper covers the spot welding of nickel, Monel and Inconel in five different gages. Optimum welding conditions were determined for each thickness of these materials in the annealed condition. The effect of sheet temper was investigated by welding two gages of nickel, Monel and Inconel in the ¼ hard state. All of the work recorded in this paper was done using conventional alternating current spot welding machines. The factors governing the size of electrode and the proper electrode pressure are discussed. The principal criterion determining optimum welding conditions was the production of high strength sound welds possessing low distortion. A method of measuring distortion is described and an arbitrary limit was selected above which the distortion was considered objectionable.

Typical characteristic curves of strength, diameter and indentation give a graphical picture of the results which may be obtained, and also show the limits required for voltage regulation. These factors are also brought out by means of tables. The load-distortion curve is inserted as a matter of interest.

A method of facilitating the set-up of welding machines in the shop by means of a "quick section" test is suggested. Photomicrographs illustrating sound

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Arc welding dump truck bodies.

Photo Harnischfeger Corp.

welds in nickel, Monel and Inconel are shown. The effects of current variation on the structure of welds in these materials is also illustrated by photomicrographs.

The results of this investigation may be summarized as follows:

1. It is possible to produce high strength, sound spot welds in nickel, Monel and Inconel sheet by using the recommended welding conditions set forth in this article.
2. Copper alloy electrodes possessing 80 percent electrical conductivity are recommended for welding these materials.
3. To insure the production of sound welds, flat, and not dome shaped electrodes must be employed with these materials.
4. Close control of the energy input is essential for the production of consistently high strength welds.
5. A method of measuring the distortion produced by welding is described, and an arbitrary limit of distortion above which undesirable welds are obtained has been established.
6. A load-distortion characteristic curve for single-spot lap-weld specimens has been obtained with the idea that such information may be of some importance in design considerations.
7. By decreasing the slope of the conical approach to the flat electrode face, the sticking of the electrodes to the sheets encountered when welding annealed nickel is minimized.
8. To aid machine set-up, two shop tests were investigated. These are known as the "peel" test and the "quick section" test. It is the opinion of the authors that the peel test is of little value. On the other hand, the quick-section test provides a fast, efficient method evaluating welds made in the shop.
9. The same welding conditions set forth for the annealed materials may be generally applied when welding material in the ¼ hard condition. It is expected that harder materials will require other settings.
10. The intergranular "coring" appearing at the ends of Monel weld sections is caused by localized melting at these points. These regions should not be mistaken for cracks.

Heat Flow in Arc Welding

By E. M. MAHLA,* M. C. ROWLAND,* C. A. SHOOK* and G. E. DOAN*

★ This research was undertaken to study the effect of carbon content, and thickness of plate on the hardness, microstructure, and cooling rates encountered in the arc welding of plain carbon steel plates. It was then attempted to develop a mathematical theory to enable the prediction of the measured cooling rates in these plates.

The hardness explorations of the cross sections of welds laid down on these plates showed that the hardness increased with both thickness and carbon content, and that the point of maximum hardness in each case was located at the root of the weld in the base plate.

Only the ¼ in. plates in the SAE 1020 and 1053 compositions, and the ¾ in. plate in the SAE 1020 steels were entirely free of martensite or martensite-troosite transformation product.

Measured cooling rates in the critical tranformation range of 1100-930 F. for the most rapidly cooled portion of each plate were approximately 50 F. per second for ¼ in. plate, 115 F. per second for ¾ in. plates, 139 F. per second for 1 in. plate, and 132 F. per second for 1½ in. plate.

A mathematical formula was developed or predicting these cooling rates which gave too high maximum temperatures and excessive cooling rates.

Design of the World's Largest Welded Flat Car

By H. MALCOLM PRIEST†

★ A specified load-carrying capacity of 500,000 lbs. brought this car to an extraordinary size and raised design problems which were successfully solved by the use of welding in fabrication.

Twelve axles are required to support the tremendous weight of over 800,000 lbs. for the car and its load. All of the requirements of the Association of American Railroads, governing the strength and safety of all cars that move over the railroads of the country, were fully met in the design. So heavy is the car that the capacity of bridges has had to be checked before routing it over the line.

The main body of the car was built of seven rolled steel beams, whose average weight was 386 lbs. per foot. Each beam, in turn, was fabricated in five sections. Welding offered the only feasible method of construction and both thermit and fusion arc welding were employed.

One of the major problems was that of handling the beams and the final assembly which weighed 148,000 lbs. Ingenious jigs accomplished this job in an efficient manner.

A few statistics in regard to the welding will convey some idea of the size of the job. In making the 28 splices, which joined the five sections into individual beams, 8,000 lbs. of Thermit were used. The seven beams were joined together along the edges of their flanges and this welding, together with that on some other parts of the car, totaled 38,400 linear feet of ¼ in. head, requiring 7,800 lbs. of electrodes and 1,400 man-hours for the operators.

Thermal Gradients in Spot Welding Electrodes

By DR. F. R. HENSEL,* E. I. LARSEN* and E. F. HOLT*

★ The paper describes the results of a series of tests which were carried out in order to determine the effect of welding conditions, electrode design and water flow, on the temperature distribution within the welding electrode.

The initial temperature measurements were made by means of thermocouples and potentiometer. It was found that this method did not give a clear indication of the actual temperature variations during welding cycles; therefore a special instrument was developed whereby a continuous graphical indication of temperature change might be obtained. This particular instrument consists essentially of an amplifier unit connected to a self-inking oscillograph. The response of this oscillograph was sufficiently fast to follow the rapid changes in the temperature of the welding tip during continuous welding operations.

The fundamental data of the paper were obtained on welding of low Carbon steel with a hard Copper alloy spot welding electrode. Some information is also contained in this paper pertaining to welding electrode temperature conditions when welding Aluminum alloys. The paper also contains a theoretical section on the mathematical calculation of temperature gradients in spot welding electrodes.

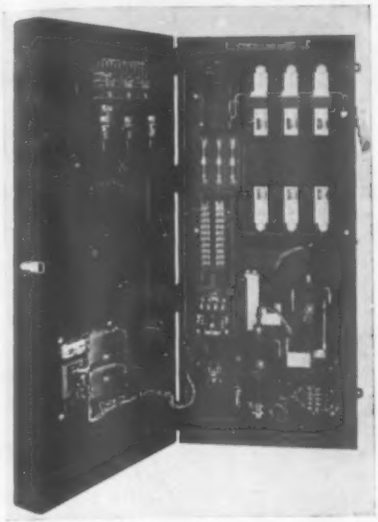
*Lehigh University.
†Engineer, Railroad Research Bureau.

*P. R. Mallory and Co.

(Continued on page 48)

More digest of Annual Meeting papers will be published next month.

New Product Developments



Everything needed for the control of resistance welding is in this compact cabinet.

Resistance Welding Control

★ Complete **Power and Control Units** for resistance welding—including, in one compact cabinet, contactors and firing relays, sequence timer, protecting fuses, limit switches, motor starter, low voltage transformer and relay, etc.—are now available from **Weltronic Corp.**, Detroit.

The complete Power Cabinets eliminate not only the necessity for the usual multiplicity of separate control units but also eliminate all external inter-unit wiring requirements, so that only the simplest of wiring is required to connect the complete set of controls to the machine, while simple three-wire connections are made to the 440 or 220 volt power supply circuit.

Similar units—without ignitron contactors and firing relays—are available for controlling operation of a wide variety of automatic machines.

Power and Control units are assembled in steel back panel cabinets to meet individual user's requirements, using standard Weltronic sub-assemblies. They are available for any type of welding equipment. Thus the units are available with a wide variety of contactors, ranging up to 600 amp. capacity, with synchronous and non-synchronous types of timers of any standard or special Weltronic type, etc.

» «

Protective Control Device

★ Complete protection against heat or excessive current, or both, is provided by a new protective control device for arc welding machines just announced by **The Lincoln Electric Co.**, Cleveland. According to the manufacturer, the new development creates advantages not previously available with conventional welder protective devices. It is said that a welding machine equipped with this new Lincoln device, which provides protection against burn-out, can be operated at maximum capacity for long periods without harm.

The protective control device, consists of two current transformers, the primaries of which are connected in series with the motor leads and the secondaries supplying power to operate two snap-action thermostats which are mounted directly on the motor lamination. These thermostats are connected to the lamination in such a way that they operate by means of heat conduction as well as by current passing through the thermostat. The thermostats automatically reset when the motor returns to a safe operating temperature or when the current is reduced, and no manual operation is required to start the machine, except pushing the start button. A special circuit allows the starter button to be held "in" after the welder thermostats have been tripped.

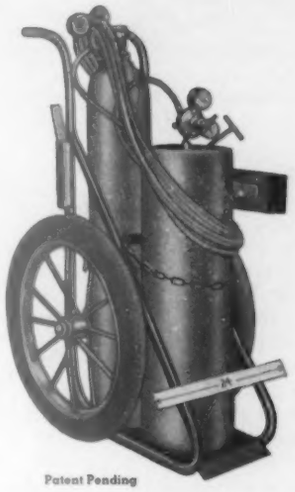
Complete protection is claimed for welders equipped with this device.

» «

Narrow-Width Cylinder Truck

★ Just perfected, this new **GAR-BRO Acetylene Tank Cart** is claimed to be unusual in three major respects: (1) It has a total width of only 24 in., enabling it to pass through any door or passageway. (2) Instead of carrying the two tanks side by side, this cart has one set behind the other, making possible the narrow width which is ideal for shops or crowded aisles. (3) The chassis is mounted on two large pneumatic tired wheels with fully depressed hubs and 30x3½ in. heavy duty tires, so that the carts may be wheeled over rough uneven ground or littered floors.

Either tank may be removed independently of the other, as the acetylene cylinder is inserted at the front while the oxygen tank is placed in the rear of the cart. The cart frame is rigidly constructed of all-welded steel tubing, and is in perfect balance at any angle. A broad, heavy bottom plate rests flush on the floor when the tank is standing, assuring steady support. A big steel tool box and two rod holders, for long and short rods, are conveniently attached to each cart. Cart is known as GAR-BRO Item No. 730-N. Manufactured by **Garlinghouse Brothers**, 2416 East 16th St., Los Angeles, Cal.



Patent Pending

Going through narrow passages is easy with this truck.

» «

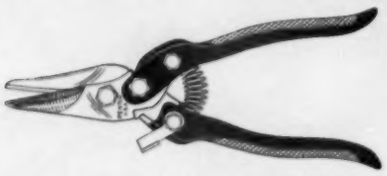
Noise Eliminators

Mine Safety Appliances Co., Pittsburgh, Pa., announce a new product for reducing the detrimental effect of noise upon workers. It is known as the **M.S.A. Ear Defender.**

It is claimed that the M.S.A. Ear Defender, which essentially is a tapered tool molded from a surgical type soft rubber, consisting of two barriers, an outer one of metal and an inner one of soft rubber, separated by an air space, are scientifically designed. The tapered construction is said to permit easy insertion and removal, without any danger of coming in contact with the ear drum.

It is likewise claimed that the Ear Defender will reduce loud noises by 35 to 40 decibels or to about 1/10th their former loudness.

These ear plugs keep out the noise but not the conversation.



A combination snip that cuts either straight or curve.

Snips

★ The newest development by the **Penn Tool Co.**, 2415 No. Howard St., Philadelphia, Pa., is their **Pentco Combination Snip**—that cuts straight, curve, either right or left. This snip is made of the finest chrome vanadium molybdenum alloy steel, hardened and tempered for rough use.

The Pentco Combination Snip is available in 3 sizes: No. 185 for light, general work; No. 190 will cut up to 16 gauge and recommended for general heavy work; and No. 195 the Giant Combination is for work up to 18 gauge.

» «

D-C Welder

★ A new 150-ampere direct-current arc welder, the **Strikeasy,** has been announced by the **General Electric Co.** for use in fabricating bright-surfaced, thin-gage metals, such as aircraft tubing (SAE-4130) which has a wall thickness of 35 mils.

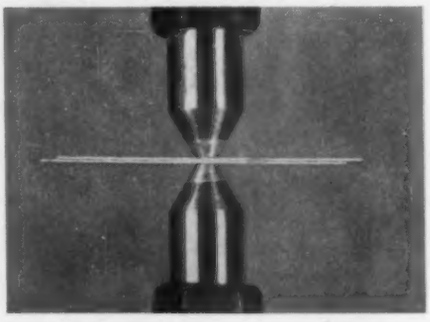
Chief among the important features claimed for the Strikeasy arc welder is its "pep" or extra high instantaneous recovery of voltage (40 to 60 volts) which helps the operator to strike the arc with ease under the difficulties presented by thin metals having a bright, polished surface. Rapid, accurate adjustment of the welding current is also provided by means of a tap switch and a rheostat. As a further aid to the operator in producing welds of uniform strength, the Strikeasy arc welder may be used with a remote-control device for reducing the current when the operator wants to fill a weld crater or when a reduction of heat is needed to avoid burn-through. Compact and easy to handle, the Strikeasy arc welder is available with or without running gear.

A new welder for the aircraft industry.

Spot Welding Electrode

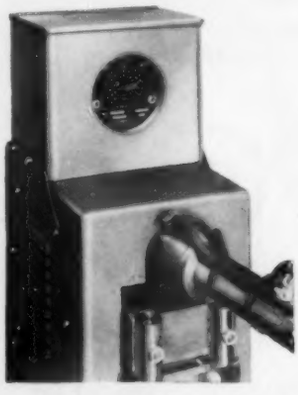
★ Designed specifically to reduce pick-up and increase resistance to mushrooming, two major problems in the spot welding of aluminum, a line of special electrodes is now available from **Progressive Welder Co.**, 3050 E. Outer Drive, Detroit, Mich.

The new electrodes are fitted with inserted tips of a special alloy having several times the resistance to mushrooming and pick-up of conventional electrode materials. The tips may be secured in virtually any type of standard or special electrode shape desired.



A spot welding electrode for aluminum.

» «



New Automatic Timer mounted with dial readily visible to operator.

Automatic Timer

★ Ace Spot Welders made by the **Pier Equipment Mfg. Co.**, Benton Harbor, are now offered with a new type of precision **Timer** for automatically controlling the welding time period. It is claimed that welding time can be quickly selected, hourly production increased, uniform welds assured.

In the development of this new automatic Timer, provision has been made for simple easy adjustment, there being three concentric scales on a convenient direct-reading dial. The adjustment range is from 3 to 47 cycles (3/60th to 47/60ths of a second), calibrated in one cycle steps. Timer is of the electronic or tube type and maximum timing variation is controlled to a plus or minus 1/120th second on short time welding. Having no relays or other moving elements, it is claimed that timing adjustments are accurately maintained.

Over 500 lbs. pressure possible with this clamp.

★ Model **No. 830 Midget Toggle Clamp** is announced by **Knu-Vise, Inc.**, 16879 Hamilton Ave., Detroit.

Furnished complete with spindle and rubber cap, measuring but four inches by one and one-half inches high it is unique that a pressure in excess of 500 lbs. is obtained with this model. Because of its small size and great holding strength the Midget Toggle Clamp is ideally adapted to aircraft work.

The Knu-Vise line of Toggle action clamping fixtures now consists of 93 different models of clamps, pliers, plier-parallels, "C" clamps, riveters, and drill fixtures.

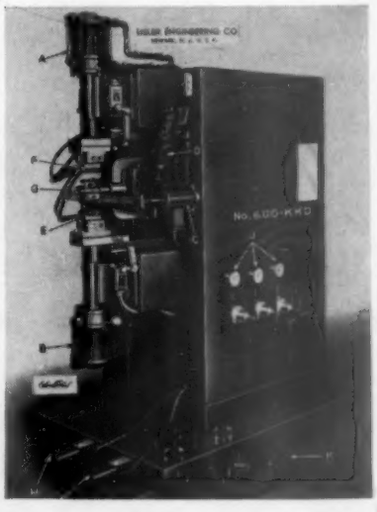
» «

Projection Welder

★ The **Eisler Engineering Co., Inc.** of Newark, N. J., has placed on the market a special Air-Operated Projection Spot Welding machine Model **No. 600-KKD.** This machine is arranged with special welding jigs and fixtures for welding fins to steel tubing. No individual jig is needed for loading the work. There are 56 points of heat control and the Transformer secondary, welding dies, and mandrel are water cooled throughout.

The rotating mandrel is operated by air and fully automatically controlled. The attached photograph is marked to point out the main features.

The pressure for each set of air cylinders can be regulated individually to meet any specific requirement. The machine is so wired that the ejector mechanism cannot operate while the welding



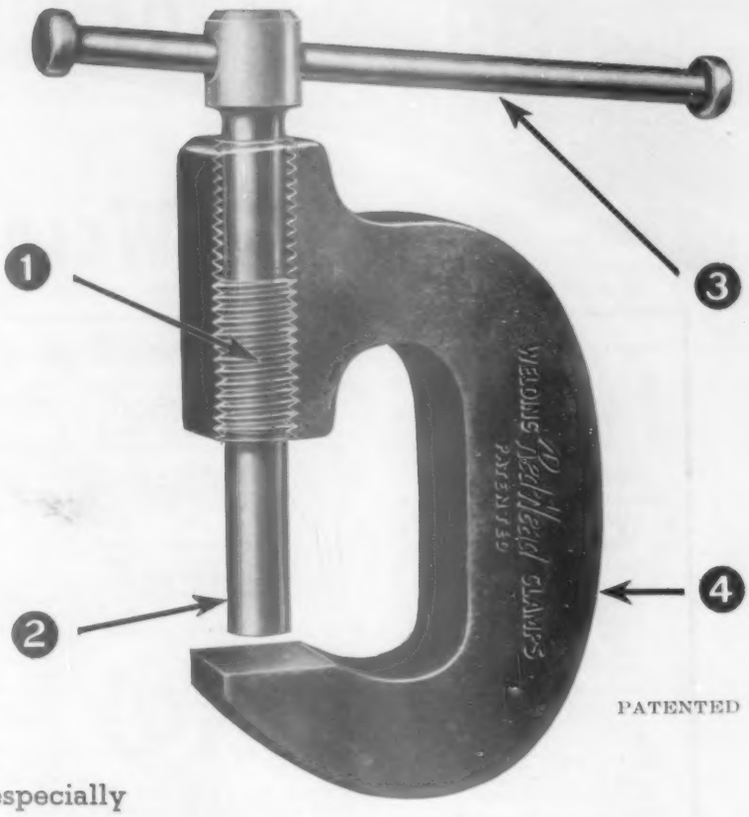
For welding fins to tubing as in bomb manufacture.

Four Good Reasons

WHY YOU SHOULD USE

"Red Head" WELDING CLAMPS

With Indestructible Concealed Threads



PATENTED

Here is a welding clamp that has been especially designed to withstand all welding and handling abuses. The concealed threads cannot become accidentally damaged or clogged with weld spatter. Spatter that does stick to the exposed surface is easily removed. "Red Head" Welding Clamps have stood up under the most rigorous service over long periods of time.

1. Threads are always protected from weld spatter and heat treated for long wear. Retains oil for long periods.

2. No threads to damage in open or closed position. Weld spatter easily removed.

3. Heat treated chrome molybdenum alloy handle offers great resistance to bending.

4. Clamp casing made from solid plate. Heat treated to give greater resistance to bending or twisting.

LIFTING CLAMPS

ALSO
SPECIAL SIZES AND
SHAPES FOR SPECIAL
APPLICATIONS

15 STOCK SIZES

• • •

A TRIAL WILL CONVINCE YOU. SEND FOR SIZES AND PRICES TODAY.

CHICAGO BOILER COMPANY

1965 CLYBOURN AVE. **CHICAGO, ILLINOIS**

HERE IS YOUR ANSWER TO EVERY WELDING PROBLEM

— in the TENTH EDITION

The WELDING ENCYCLOPEDIA

Typical Questions Discussed in this Book

In welding aluminum and its alloys what flame adjustment is recommended? How would you estimate costs and materials? In arc welding, what electrode manipulation should be used?

Annealing—What can annealing do for a weldment? Is the metal structure improved? What are recommended practices?

Boiler Welding—What are the provisions of A. S. M. E. Boiler Construction Code? What are limits of pressure and temperature under Paragraph U-69?

What is the temperature of the oxy-acetylene flame? The electric arc? Thermit reaction?

What metals, welding methods and procedures are used in aircraft welding?

What method of welding has greatly simplified the welding of copper?

Does the oxy-acetylene cutting flame have any effect on cut edges of steel?

What are the common "Designs" of welds? Where and how are they used to best advantage?

What properties and characteristics would you look for in selecting electrodes for resistance welding?

How would you go about redesigning machinery for welding? Can a combination of steel castings and rolled steel be used to advantage?

Can malleable iron be welded? What are characteristics of this metal? How can you identify it?

Where is manganese steel used most widely? What should be known about this metal before starting to weld?

What are the melting points of various metals?

What should the welder know about the structure of metals? of the composition of metal and non-metallic elements? about the Iron Carbon Diagram? See "Metallography."

What are the possibilities of Metal Spraying? Where can it be used effectively and what metals are adaptable to such application? What results may be expected? See "Metal Spraying."

In welding stainless clad steels, what procedure would you follow? Which side should be welded first?

How does a molten puddle of steel react under the three adjustments of the oxy-acetylene flame, i.e. neutral, oxidizing and carbonizing?

What flame adjustments are recommended for the different metals?

Preheating—Can you name the three important reasons for its use? How does shape of piece govern point where preheating is applied?

How many codes are in existence which govern welding? To what specific types of welded fabrication do they apply? Name requirements of each?

What is indicated by results of reduced-section tension test? free-bend test? root-break test? side-break test? nick-break test? How is each made?

Where can silver solders be used to advantage? What metals are particularly adaptable to this process? Is joint design important?

What are content and designation of the most frequently welded metals? See "Specifications for Materials."

In welding Stainless Steels, what properties of the two general classes of these metals must be kept in mind?

In designing welded Structural Joints, what unit stresses (shear, tension and compression) are permitted under A.W.S. Building Code.

What kinds of metal and what shapes are best adapted to Flame Hardening? What advantages has it over furnace hardening?

What are the various forms of welded joints? What are root, leg, toe, face and throat of a weld?

Name qualification tests required for welding large steel tanks? What is the most economical design for open rectangular tanks?

What is the reaction in Thermit welding? Where is the process especially useful and what preparation is necessary?

What shop exercises are essential in a training course for oxy-acetylene welders? for arc welders? What shop equipment is necessary? See "Training Operators."

Welding Rods and Electrodes —Specifications for various A.W.S. grades are given as well as tensile requirements of all-weld metal coupons.

How are Welding Symbols used and how do they simplify detail drawings and shop blue prints?

What is "Arcronograph," "Avialite," "Blackor," "Borium," "Calobar," "Mangamal," "Polygraph"? Who makes it? All leading trade names with manufacturer's name and address are given.

All the welding information — new developments, experiments and research — has been carefully selected, condensed to essential detail and simply presented. On the job, on your desk, in the draftng room or in the plant, this new book gives you instantly the information you need.

The Trade Names of welding, incorporated in The Welding Encyclopedia, serve an important need of industry. It is the only compilation of its kind giving instantly a brief description of the item, the name and address of the manufacturer. Arranged alphabetically in the text of the book.

The Welding Industry Buyers' Manual, printed on a special india paper for quick location, contains the sales messages of the leading welding manufacturers—data and information gathered under one cover for your use.

THE WELDING ENGINEER PUBLISHING CO.
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Please enter my order for (1) a copy of The Welding Encyclopedia at $5.00 and (2) The Welding Engineer for 1 year at $3.00, total $8.00. My check ( ), money order ( ) is enclosed for **$6.50 in full payment for both. I save $1.50.**

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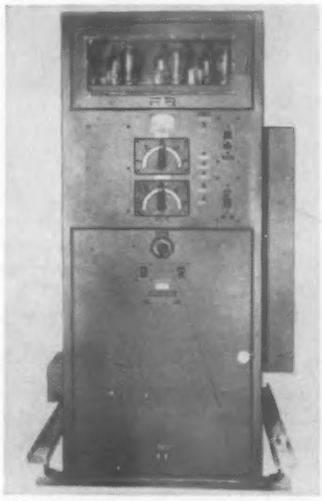
dies are in motion, nor will the welding dies operate while the ejector mechanism is in motion. The actual welding time is controlled by automatic timing equipment.

» «

Capacitor-Discharge Control

★ A new **capacitor-discharge control** specially designed for use with stored-energy type resistance-welding machines has been announced by the **General Electric Co.**, Schenectady, N. Y.

The control cabinet contains up to 22 capacitors, any number of which can be used at one time. Two special tap switches select the number of capacitors desired in one-unit steps, each of 120 microfarads. By adjusting the voltage output of the control, and by selecting the number of capacitors, flexibility in welding is assured. A special circuit which prevents operation of the welding machine if the capacitor voltage is more than 3 per cent below its preselected value reduces the possibility of insufficient energy to produce good welds.



Another control for stored-energy resistance welding.

Several safety devices are furnished with this control. A discharge contactor discharges the capacity units remotely by means of a push button if necessary. A manually operated 3-phase circuit breaker protects the anode transformer in case of a short circuit. If any of the cabinet doors are opened, interlocks automatically discharge the capacitors through the discharge contactor. In addition, a discharge bar is mechanically operated to short out those capacitors which were in use at that time. The remaining capacitors are shorted by means of the special tap switch.

» «

A-C Welder

★ **U. S. Protected Arc Welder** is the name of a new A-C welder announced by the **U.S. Electric Welder Corp.**, Toledo, Ohio. Featuring a single dial for simpler control, this A-C Welder has 60 heat step selections from 20 to 350 amps. Although it covers a wide range of welding currents, the welder is very compact in that it measures only 21 in. long, 14 in. wide and 23 in. high.

» «

Protective Metal Coating

★ A new metal coating compound, marketed under the name of **AMCO Metallic Coating Powder, Brand "K"** has been developed by the American Solder & Flux Co., Philadelphia.

This new product is designed for making repairs to damaged tin coatings. While the finished coating has the appearance of tin and matches perfectly with the surrounding hot dipped tin coating, it has an advantage not possessed by the original tin. AMCO Brand "K" Coatings are claimed to be completely rust resistant and will protect the underlying iron or steel to the same extent as hot dipped zinc coating of the same thickness. This unusual and important claim of the AMCO Brand "K" Coating is due to the fact that when in contact with iron or steel in a corrosive medium, it is electro-positive and therefore affords protection against rust and corrosion.

Welding Rods . . . not too plentiful, BUT . . .

if you need stainless electrodes for defense work, alloy and hard surfacing rods or other electrodes for special, out-of-the-ordinary applications, we can probably help you. Call the nearest Ryerson plant.

Electrodes in stock include:

McKay Stainless—7 types

Ryerson Shielded Arc — for Mild Steel and Alloys

Blue Coated — For Cast Iron

Phosphor Bronze—For Brass and Copper

Hard Surfacing Rods

Acetylene Welding Rods

●

Joseph T. Ryerson & Son, Inc. Plants at: Chicago, Milwaukee, St. Louis, Cincinnati, Cleveland. Detroit, Buffalo, Boston, Philadelphia, Jersey City.

RYERSON

Respirator

★ The new and improved **M. S. A. Single Filter Dustfoe Respirator** has been announced by **Mine Safety Appliances Co.**, Pittsburgh, Pa.

Featured improvement of the Dustfoe is the new single filter which replaces the two-part (felt screen and cellulose) filters used previously. This new filter is all in one piece, giving U. S. Bureau of Mines-approved protection against an even broader range of dusts and mists, states the manufacturer. The filter is more porous on the outer side so that the larger dust particles are filtered out first, thus preventing rapid build-up of breathing resistance through clogging of filter.

Other well-known features of the M. S. A. Dustfoe Respirator are retained. The compact, lightweight unit offers low breathing resistance and full vision in every direction. A protective filter cover prevents contamination of filter by grease and dirt from hands and equipment. A foolproof exhalation valve —leakproof Army Gas Mask Type— provides drainage. The formable facepiece of the Dustfoe may be shaped to fit individual face contours.

Easy breathing and full vision claimed for this respirator.

A-C Welder

★ **Marquette Mfg. Co., Inc.**, Minneapolis, Minn., announce a new group of **A-C Arc Welders** known as the 160 Series. These new welders which are of the transformer type, are obtainable in four models. Model 160 which has an amperage range from 20 to 125 amps, Model 161 with its range of 20 to 175 amps., Model 162 which has an amperage range from 20 to 250. All of these models are mounted on swivel castors for easy movement about the shop. However, there is also obtainable, a Model 162 T which is the same as Model 162 except that it is mounted on a specially designed heavy duty four wheel truck with a crane eye attached to the top for easy portability.

All models are designed for 220 volts. Welders for operation on 440, 550 or special voltages may also be obtained if desired.

Castors and lifting eye make it easy to move about the shop.

DEFENSE WELDING

IS DEFINITELY

C-F Positioner Welding

★

In the armament section of American Machinist for September the manufacture of arc welded gun carriages is described, in part, thusly . . . . "Since all welding is down-hand, positioners are used wherever required." The positioners shown are C-F Welding Positioners. Not only here, but throughout industry, these time-saving machines which permit faster and better welding are definitely part of the defense job, in armaments, shipbuilding, transportation; everywhere. Investigation will probably show you that C-F Positioners will make your production welding simpler and more economical.

C-F Positioners are available in hand operated or power driven machines with capacities from 1200 to 14,000 lbs.

Our bulletin W P 20 will give you the facts. It is illustrated, interesting and free upon request.

CULLEN-FRIESTEDT CO.

1309 S. KILBOURN AVE. CHICAGO, ILLINOIS

News of the Industry

Purdue Welding Meeting

The **Seventeenth Annual Conference on Welding** will be held at **Purdue University,** Lafayette, Ind., Dec. 11-12, according to an announcement by Professor R. W. Lindley.

» «

Colonel Alfred H. White, head of the Department of Chemical and Metallurgical Engineering at the University of Michigan, announced today that **The Dow Chemical Co.,** is to receive the 1941 award for chemical engineering achievement based on its pioneering research in the recovery of metallic magnesium from sea water. This award is made by the magazine, *Chemical and Metallurgical Engineering* of New York to that company, which in the opinion of the Committee of Awards has "contributed the most meritorious advances to the industry and profession," since December, 1939.

Trade News

Ampco Metal, Inc., Milwaukee, Wis., has announced that plans are in progress for constructing two more additions. These are a Machine Shop addition, 120 ft. by 120 ft., and a Forge Shop addition, 100 ft. by 100 ft. Work will start this fall, and $250,000 has been authorized to construct and equip the new projects. The new buildings will be constructed to the west of the present plant.

» «

Tube-Turns, Inc., Louisville, Ky., manufacturers of welding fittings, have appointed **Jack W. Green** as manager of their Chicago office and the surrounding territory.

Mr. Green has been associated with Tube-Turns, Inc. in both the Louisville and Chicago offices. He has also had wide familiarity with the Tube-Turn Welding Fittings and industrial piping generally through his connection with American Radiator and Standard Sanitary Corporation as manager of their Akron, Ohio, branch for over twelve years.

Personals

Charles E. Wilson, President of the General Electric Company, announced the election of five new vice presidents by the board of directors of the Company. The new officers are: **Walter R. G. Baker, Chester H. Lang, David C. Prince, Elmer D. Spicer,** and **Harry A. Winne.**

The new officers were elected in connection with a major change in the company's organization. Under the new setup, the company will have four major operating departments: Appliance and Merchandise, under Vice President Hardage L. Andrews; Radio and Television, under Vice President Baker; Lamp, under Vice President Joseph E. Kewley; and the Apparatus Department which, because of its great volume of business and diversification of products, will be staffed by five vice presidents, whose duties will be along functional lines. These Vice Presidents are: Mr. Lang, in charge of defense activities and also continuing as Manager of Apparatus Sales; Mr. Prince, in charge of application engineering — Apparatus Department; Earl O. Shreve, in charge of commercial activities, Apparatus Department; Mr. Spicer, in charge of manufacturing—Apparatus Department; and Mr. Winne, in charge of design engineering —Apparatus Department.

Vice President William R. Burrows, formerly in charge of general manufacturing operations, and Vice President Roy C. Muir, formerly in charge of general engineering operations, will become members of the president's staff, carrying out assigned duties in these respective fields.

Improved...
with A New Coating

USE AMPCO-TRODE FOR ANY TYPE OF WELD!

Rods from 1/8" to 1/2" in diameter — and in six grades of strength, from 50,000 to 80,000 p.s.i. and hardness from 100 to 375 Brinell—easily used with metallic arc, carbon arc, or oxy-acetylene processes, on steel, cast iron, brass, bronze, and nickel alloys.

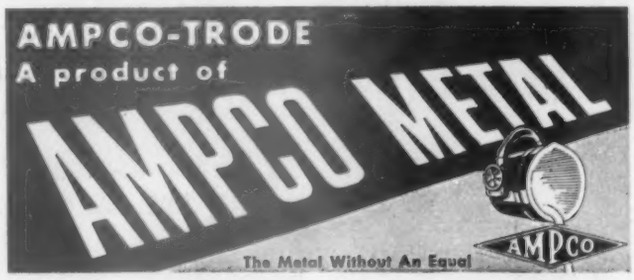
Now you can get Ampco-Trode, the only coated aluminum bronze welding rod, with an improved coating. The new coated rod makes it easy for the most inexperienced welder to obtain a porous-free deposit by all welding methods. It has much smoother arc action, and the slag is easier to remove.

Made with the properties of Ampco Metal, the rod has high physical properties that make it suitable for tough jobs subject to impact, "squashing out" and wear on sliding surfaces. Use Ampco-Trode for overlaying steel and cast iron, building up shafts, wear strips, valve seats, and other parts, refacing for extreme wear-resistance, and building up large forming and drawing dies. It is suitable for metallic arc, carbon arc, and oxy-acetylene welding.

AMPCO METAL, INC.
Department WR-11 Milwaukee, Wisconsin

Write for Complete Information

Ask for a new bulletin, giving full details of physical properties and applications of AMPCO-TRODE. Our engineers are at your service.



A relocation of duties at **Caterpillar Tractor Co.**, Peoria, Ill., pursuant to election of Louis B. Neumiller as president of the organization, has been announced.

T. J. Connor, Vice President, is assigned general supervision of the industrial relations department and training and public relations department in addition to the departments of manufacturing, engineering and purchasing, which he had previously administered.

T. R. Farley, Vice President, has been assigned direction of the parts and service departments, which duties he will handle in addition to direction of the merchandise department.

General supervision of the traffic department, formerly conducted by Mr. Farley, has been assigned William Blackie, Company controller.

» «

Cecil V. Eskridge, of The Linde Air Products Company, New York, N. Y., died in Chicago, Ill., on September 21 at the age of 43. He had been associated with Linde since 1924, and represented the Company in working with steel mills as a specialist in oxy-acetylene deseaming operations.

» «

Ampco Metal, Inc., Milwaukee, Wis., announce the following personnel changes: **Frank A. Burnett,** formerly manager of the Cincinnati office has been promoted to manager of the Indianapolis office. **E. A. Svoboda** has been transferred from Indianapolis to Cleveland to take charge of that office, replacing **J. A. Morrison** who has resigned from the Ampco staff. **Russell E. Campbell** has joined the West Coast division of Ampco and will work with **O. D. Cooper** in aviation and industrial fields on the Pacific Coast.

» «

William Beye, Vice President, U. S. Steel Corp. of Delaware, died at his home in Pittsburgh, Pa., Oct. 27. Mr. Beye, who was born in Chicago, July 21, 1881, was educated in the public schools and graduated from the University of Wisconsin, 1902, and Lake Forest, 1904. He was admitted to the Illinois Bar and from 1904-1937 practiced in Chicago as a member of the firm Knapp, Beye, Allen and Cushing, Advisory Counsel for the subsidiaries of U. S. Steel Corp.

He was elected Vice President, United States Steel Corporation in charge of Industrial Relations, in 1937. Upon the organization of the U. S. Steel Corp. of Delaware in 1938 he became Vice President and General Counsel. During his entire career Mr. Beye was interested in the broad aspects of industrial relations and was credited with the authorship of the Illinois Workmen's Compensation Act.

» «

The following personnel changes at Gary works of Carnegie-Illinois Steel Corporation have been announced: **H. S. Brink,** formerly assistant plant industrial engineer, becomes plant industrial engineer. **E. H. Gott** has been transferred from the industrial engineering department to the maintenance department where he is assistant division superintendent. **A. F. Giese, Jr.,** formerly superintendent of the 44-in. blooming mill and 36-in. slab mill, becomes division superintendent of maintenance. **J. F. Frain,** formerly superintendent of the 12-in. No. 1 merchant mill, becomes superintendent of the 44-in. blooming and 36-in. slab mill. **W. N. Nagel,** who was assistant to division superintendent of the plant maintenance division, has been appointed assistant plant industrial engineer. **F. L. Collins,** formerly assistant division superintendent of power and fuel, becomes electrical engineer. **H. R. Middlebrook,** formerly assistant division superintendent of maintenance, has been appointed assistant division superintendent, power and fuel.

» «

James W. Parker, vice-president and chief engineer of the Detroit Edison Co., has been elected president of The American Society of Mechanical Engineers for 1942.

Vice-Presidents elected at the same time to serve two-year terms on the Council of the A.S.M.E. were **Clarke F. Freeman,** senior vice-president and engineer of the Manufacturers Mutual Fire Insurance Co. and its associated companies, Providence, R. I.; **C. B. Peck,**

You can always Depend on MILBURN

FINISHING, CUTTING and WELDING EQUIPMENT

TYPE OM SPRAY GUN—Light in weight, compact. Operates as production unit for continuous service or for touch-up work. Features "Hollow Air" atomizing principle. Top efficiency with all types of spray material.

MILBURN CUTTING AND WELDING TORCHES—Sturdily constructed to highest government standards. Illustrated is the Type HMS—a modern development in the welding art. With attachments it can be used for welding, brazing, soldering and cutting.

MILBURN CUTTING AND WELDING TIPS—Made of special rolled copper and embody outstanding features to give high efficiency, longer life and lower consumption of gas. Interchangeable.

Write for complete catalog of paint spray equipment, welding and cutting apparatus and regulators.

The **ALEXANDER** MILBURN *Company*

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managing editor of *Railway Mechanical Engineer*, New York, N. Y.; **W. H. Winterrowd,** vice-president of The Baldwin Locomotive Works, Eddystone, Pa.; and **W. R. Woolrich,** dean of the College of Engineering, and director of the Bureau of Engineering Research of the University of Texas, Austin, Texas.

Managers of the Society elected to serve on Council for three-year terms include **W. G. Christy,** smoke-abatement engineer of Hudson County, New Jersey; **H. L. Eggleston,** manager of the gas and refining departments, Gilmore Oil Co., Los Angeles, Cal.; and **T. S. McEwan,** who was last year selected to head the defense contract service of the Office of Production Management in Chicago as district manager.

The new officers will be installed during the 62nd Annual Meeting of the Society in New York, N. Y., at the Hotel Astor, December 1-5, 1941.

» «

The appointment of **Thomas A. Jordan** as assistant division engineer, western division, of the American Bridge Company, succeeding F. W. Dencer who is retiring after forty years of continuous service, has been announced.

Mr. Jordan began his service with the Bridge company in 1910 as a draftsman at the old Lassig plant in Chicago. Nine years later he was transferred to the Chicago office where he served as designer until 1930. He was made assistant engineer in charge of design at that time and remained in this capacity until receiving his present appointment.

Obituary

Ford R. Lamb, Executive Secretary, Past President, Charter Member and for years guiding spirit of the American Society of Tool Engineers, died at his home in Pinckney, Mich., October 26th, at the age of 50.

Born in Williamstown County, Michigan, on June 28, 1891, he attended the Perry Michigan High School and Lansing Business University. Following a few years in various jobs, learning the fundamentals of tool designs, etc., he joined Studebaker Corporation in 1920, gradually working his way up to Assistant Production Engineer in 1927. He left Studebaker and joined the Detroit College of Applied Science as Instructor in Tool Design and as Treasurer.

Having invented a "stud setter" in 1928, he took his invention to the Consolidated Machine Tool Corporation with whom he was connected in the capacity of Sales Engineer until 1937. In 1936 he was elected President of the American Society of Tool Engineers—its fifth. When his term of office expired in 1937, the Society was loath to see him relinquish office. It offered to him a new post—that of Executive Secretary of the A.S.T.E.

» «

Harry J. Lehman has been appointed to succeed the late H. B. Whitaker as Providence district manager of the **Bridgeport Brass Co.** with offices at 70 Clifford Street, according to an announcement by Herman W. Steinkraus, vice-president.

Before joining the company last year as a salesman in the Boston and Providence district, Mr. Lehman had for many years been district sales manager in that territory for Scovill Manufacturing Company.

Alfred V. Archer, who had charge of the Providence warehouse under Mr. Whitaker, will continue in that capacity, and will also become a sales representative.

A. G. Montgomery, Assistant Chief Engineer of the American Steel & Wire Co., died at St. Alexis Hospital, Cleveland, October 10.

Mr. Montgomery was 54 years old and was born in Volga City, Iowa. He was graduated from Pennsylvania State College, as an electrical engineer and joined the American Steel & Wire Company as District Engineer in Pittsburgh in 1914. He has held a variety of engineering positions with the company, in Pittsburgh and Cleveland, and was appointed Assistant Chief Engineer in 1939. He served as a lieutenant in the U. S. Army during the World War.

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Trade Mark Registered

TITAN BRONZE WELDING ALLOYS

—preferred by experienced welders from coast to coast — are the result of many years of TITAN pioneering.

DOUBLE DEOXIDATION, developed by TITAN metallurgists, eliminates injurious gases and assures *increased ductility plus greater strength* in the weld deposit.

Our production facilities are being used to their utmost capacity to make available Titan products necessary to the Defense Program. We regret that these requirements are currently in such volume that until this program is completed it will be impossible to fill the requirements of new customers unless they bear a priority rating.

Send for newly-issued folder describing TITAN Alloys. No obligation.

TITAN METAL MANUFACTURING CO.
Bellefonte, Pennsylvania

Annual Meeting Digest

(Continued from page 38)

Training Welders for National Defense

By JAMES A. WALN*

★ When an occupation, such as welding, becomes so vital to the fabrication of modern military equipment that a shortage of persons skilled in that occupation threatens to constitute a major bottleneck in the defense of the nation, a report on training to prevent that shortage seems timely. An overview of the nationwide program of welder training for national defense is therefore presented with the intent of portraying its importance, its nature, and its problems, through the presentation and discussion of these major aspects of the program: (a) the need for training; (b) Federal aid; (c) the scope of the training; (d) selection of trainees; (e) the instructor; (f) qualifying tests; (g) equipment; (h) costs; (i) typical courses; and (j) teaching units.

Conclusions presented or intimated are felt to represent the experiences of the many welding supervisors and instructors with whom the author has associated since the beginning of the national defense training program.

When the nation became defense conscious, we were at the end of a decade of depression and recession during which time training in public and private vocational schools was greatly curtailed and training within industry was almost forgotten. As a result we were faced in 1940-41 with a shortage of skilled workers, trainees, and persons familiar with training procedure. Among the steps taken by the Federal Government to aid defense industries in alleviating the shortage of skilled labor were: (a) the establishment of the Training Within Industry section of the Office of Production Management and (b) the Congressional appropriation of funds to the U. S. Office of Education for the operation of courses in occupations essential to national defense.

With this aid vcational schools are assisting defense plants in increasing the abilities of their welders through supplementary training courses, and by furnishing the industries with more welding operators through preemployment courses. Highly essential factors in the program are the proper selection of equipment, supplies, trainees, and instructors.

Defense training courses of the preemployment type cannot be expected to go farther than the development of the skill of manipulating an electrode or torch, obtaining thorough fusion, keeping the weld free from slag, and recognizing conditions that may produce excessive porosity. The guided bent test is an accepted procedure for testing trainee's ability to apply the experience and knowledge gained during training, and to determine his fitness to enter industry as a beginner-welder on simple production welding. It is now generally recognized that welding schools should confine their preemployment training to preparing trainees to pass the "limited" qualification test on 3/8" mild steel plate, using (for arc welding) where possible 5/32" diameter coated electrode of reverse polarity type to the AWS specification E6010. The training of welding operators for the "unlimited or 1" plate test should be attempted only in supplementary courses for welders who are able to pass the "limited" qualifying test and who have had a reasonable amount of experience in welding.

It is common practice for employers to hire welding operators from preemployment training classes and then encourage them to return to the school, even on company time, for supplementary training, after some experience has been gained on the job.

The length of time required to train a welding operator seems to depend upon his aptitude and the welding job for which he is being trained, providing of course that the proper equipment, supplies, and instructions are used. Statistics on this and other items of interest in the training of welders for national defense will be presented at the Annual Meeting of the American Welding Society.

» «

The man who pulls the oars doesn't have time to rock the boat.—*Mack Clip*

*Special Representative for Trade and Industrial Education, U. S. Office of Education.

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POWER-TILT BY COMPRESSED AIR WITH POSITIVE HYDRAULIC LOCKING IN ALL POSITIONS

Power-Tilt Model AM-5

Automatic Indexing of Rotation with Selective Permanent Disengagement for Circular Welding.

Bench Height Table Lifts as It Tilts.

Capacity 500 Pounds with Center of Gravity 12 inches Above Face Plate.

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HAND-TILT MODEL MM-5

AVAILABLE FOR

LIMITED TILTING OPERATIONS

Eliminate Waste of "Welding Power"—

Equip Every Booth with at Least a Low-Cost MM-5 Producter.

IMMEDIATE DELIVERY FROM STOCK

ONE and FOUR Ton Capacity PRODUCTERS available with Electric Drive.

BENTLEY WELDERY, INC. SYRACUSE, N. Y.

MANUFACTURERS OF "PRODUCTION POSITIONERS"

Welding as Applied to Locomotives

By JAMES PARTINGTON*

★ Electric arc welding, gas welding and forge welding were in use to a considerable extent in the construction of new locomotives and the repair of locomotives that were in service in the early part of the 1910 decade.

On new work butt welds in locomotive fireboxes were made first with oxy-acetylene and later by electric arc welding, using bare wire. In applying patches in locomotive fireboxes the same methods were used. All of these welds were in the staybolted areas of the firebox and gave satisfactory results—the welds being supported by other means.

In some railroad shops repairs were made to the shell portion of locomotive boilers by electric arc welding, the welds being made from the outside only. These welds were not stress-relieved and would not meet the test requirements of present-day codes, nor the procedure rules of the American Welding Society. They were generally unsatisfactory—new cracks soon developed when the locomotives were put back into service.

These conditions caused the Bureau of Locomotive Inspection of the Interstate Commerce Commission to issue orders prohibiting all welding on the pressure parts of locomotive boilers and permitting only the welding in the fireboxes as above outlined with the provision that no firebox welds be allowed higher than 14 in. below the top of the crown sheet. Due to the improved methods which were gradually developed by following the welding rules, promulgated jointly by the American Welding Society and the Boiler Code Committee of the American Society of Mechanical Engineers, including the use of covered electrodes in place of bare welding wire, completely welded fireboxes are now permitted. These completely welded fireboxes are now in general use and are giving satisfactory service.

By special permission of the Bureau of Locomotive Inspection of the Interstate Commerce Commission, one completely welded boiler was built by the American Locomotive Company. This boiler was built in accordance with the rules of the A.S.M.E. Boiler Code for Power Boilers and the design and construction procedure were approved by the Mechanical Division of the A.A.R. This boiler has been in successful operation on the Delaware and Hudson Railroad for the past four years. No additional completely welded boilers for locomotives have yet been permitted although two railroads at the present time wish to put welded boilers in service.

Other important items of fusion welding now in general use for locomotive boilers are:

Welding of staybolt sleeves and caps.

Welding of the firebox door hole seam.

Welding of washout plug sleeves.

Welding of smokeboxes.

Important items of fusion welding on other locomotive parts are:

Welding of cabs and Diesel locomotive hoods.

Welding of ash pans.

Welding of locomotive tender tanks.

Welding of the sheathing of streamlined locomotives.

Welding of Diesel locomotive underframes.

Welding of electric locomotives.

Fusion welding in railroad shops has been greatly improved in quality in recent years. Many railroad shops are following closely the A.W.S. procedure for process and for qualifying their welders.

Two striking examples of welded construction fabricated in railroad shops are: Welded cylinders and welded hinge connection for articulated locomotives.

The application of fusion welding to locomotive parts is not restricted by the I.C.C. and welding is extensively used on new work and in making repairs.

The use of welded parts on new locomotives has advantages as follows:

Neater appearance;

Saving in weight;

Reduction in development costs by the elimination of patterns.

The advantages of welding in making repairs are similar to those realized in other industries. The outstanding prospect of the further extension of welding as applied to locomotives will be realized when the I.C.C. permits the general use of welded boilers.

*Manager Eng. Dept., American Locomotive Co.

A YEAR'S DELAY SAVED BY BRONZE WELDING!

Fractured spokes of 24 ft. flywheel repair welded with Anaconda 997 Low-Fuming Bronze Rod in 56 man hours

When two spokes of this giant flywheel were broken, it appeared as though a blast furnace with scheduled defense production would be out of operation for a long time.

The Hebeler Welding Company, Buffalo, was called in as soon as it was learned that a new wheel probably could not be delivered for a full year.

In just 56 man hours, the Hebeler men completed the job with about 300 pounds of Anaconda 997 Low-Fuming Welding Rod. An insurance company then insured the repaired wheel, which once again proves the statement that good workmanship plus a good material equals dollars —and time—saved! 41197

ANACONDA Anaconda Welding Rods

THE AMERICAN BRASS COMPANY, General Offices: Waterbury, Connecticut
Subsidiary of Anaconda Copper Mining Company
In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.

Trade Literature

Arc Welding Film

A new series of films on arc welding is being produced by **Raphael G. Wolff, Inc.** of Hollywood. These films are in full color 16mm with sound; and are designed for use in teaching. The welding arc is shown and explained in the most simple and direct manner, through live action photography combined with animation.

The first film—a 400-foot subject—**"The Inside of Arc Welding,"** will be available in December to the welding industry and to trade and technical schools.

TO HELP YOU "KEEP 'EM FLYING!"
RECORD G-R WELDER PRODUCTION HITS NEW HIGH . . .
With new manufacturing facilities now in operation, precision-built G-R welders are being completed at a pace that has not only licked the staggering backlog of orders, but also permits us in many cases to make that rarely-heard offer . . . "PROMPT DELIVERY"!
Whether your welding job involves light or heavy amperage, single or multi-operator manual welding or heavy duty automatic or Unionmelt operation, there's a standard G-R unit available. Cost-cutting Remote Control and Power Factor Correction can also be furnished. Anticipate your requirements . . . then phone your jobber or wire us NOW for data and details.
GLENN-ROBERTS COMPANY
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The Improved **SIMPLEX** Electrode Holders

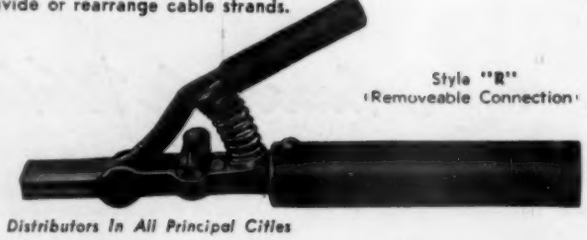
Practical—Economical—Light

WEIGHT 15 OZ. EACH 1/16" to 1/4" ELECTRODES

STYLE "S" (Soldered Connection)

Jaws of heavy copper alloy of sufficient current capacity and strength to withstand duties of its class. Sturdy compression spring supported by heat resisting insulating seats. Current can not pass through spring. Insulating fibre handle permits firm balanced grip. STYLE "S" (Soldered connection) has rear end of fixed jaw cored to receive cable, insulating handle covers connection. STYLE "R" (removeable connection) carries cable to a point ahead of handle where it is firmly clamped to prevent heating. Unnecessary to divide or rearrange cable strands.

Send for large, profusely-illustrated Catalog No. 20.



Style "R" (Removeable Connection)

Distributors In All Principal Cities

THE FIBRE-METAL PRODUCTS CO. CHESTER, PENNA.

Progress

"Air Reduction A Quarter Century of Progress" is a new 54 page spiral bound book recently released by **Air Reduction Co., Inc.** In this beautifully illustrated booklet there is a detailed description of the activities of the five companies which comprise Air Reduction Co., Inc. With pictures and diagrams, as well as descriptions and data on historical backgrounds, the methods, the markets and the natures of the business activities are told.

On many of the pages it is pointed out how the products of the various subsidiary companies are playing a vital part in numerous industries now engaged in National Defense. The activities of the five Airco operating companies, namely, the Air Reduction Sales Co., National Carbide Corp., Wilson Welder & Metals Co., the Pure Carbonic, Inc., and the Ohio Chemical and Manufacturing Co., in shipbuilding, aviation, explosives, manufactured gas, sheet metal products, steel works and rolling mills, refrigeration and medical field, are described. The book is concluded with a very interesting chart picturing the manner in which the various products of the operating companies tie into practically every industrial process known to man.

» «

Control Bulletin

The **Weltronic Corp.**, Detroit, Mich., announce the release of a new 4 page bulletin, **S-41.** In this bulletin there is described the various heat controls, synchronizers and synchronous timers and complete machine control produced by the Weltronic Corp. In addition to illustrating these various controls, there are given diagrams to show how they may be hooked into various welding circuits to perform the desired duties.

» «

Shears Bulletin

In a new 8 page bulletin, QW 102, entitled **"Auxiliary Attachment for Quickwork Whiting Rotary Shear"** issued by the **Quickwork Whiting Div.**, Whiting Corp., Harvey, Ill., there is described the many attachments and uses to which the Quickwork Rotary Shears may be put. It is shown how, by the use of auxiliary attachments, it is possible to cut circles, slit and flatten sheets or plates, joggle plates, flange plates or by the aid of an indicating and signaling device, accurately cut plates one in. thick or less, to a desired line.

» «

RegO LP Gas Pocket Guide

★ **The Bastian-Blessing Co.**, 4201 Peterson Avenue, Chicago, is offering to the liquefied petroleum gas industry a convenient reference manual in the form of the RegO LP Gas Pocket Guide.

The Guide contains basic data, charts, tables and other information relevant to the industry. It coordinates technical and specialized knowledge in connection with the merchandising and handling of liquefied petroleum gases and is prepared primarily to help the dealers' salesmen and servicemen to a better un-

Melting Points

ELEMENT	CENT.	FAHR.	ELEMENT	CENT.	FAHR.	ELEMENT	CENT.	FAHR.
Hydrogen	—259	—434	Zinc	419	787	Iron	1,530	2,786
Oxygen	—218	—360	Tellurium	452	846	Palladium	1,549	2,820
Nitrogen	—210	—346	Antimony	630	1,166	Zirconium	1,700?	3,090?
Chlorine	—102	—151	Cerium	640	1,184	Thorium	1,700?	3,090?
Mercury	— 39	— 38	Magnesium	651	1,204	Vanadium	1,720?	3,128?
Phosphorus	+ 44	+111	Aluminum	659	1,218	Platinum	1,755	3,191
Potassium	62	144	Calcium	810	1,490	Titanium	1,800?	3,272?
Sodium	97	207	Arsenic	850?	1,562?	Rhodium	1,950?	3,542?
Sulphur (S_1)	113	236	Barium	850	1,562	Boron	2,200?	3,992?
Iodine	113	236	Silver	960	1,761	Iridium	2,350?	4,262?
Lithium	186	367	Gold	1,063	1,945	Ruthenium	2,450?	4,442?
Silenium	218	424	Copper	1,083	1,981	Molybdenum	2,500?	4,532?
Tin	232	450	Manganese	1,260	2,300	Osmium	2,700?	4,892?
Bismuth	271	520	Silicon	1,420	2,588	Tantalum	2,805?	5,160?
Thallium	302	576	Nickel	1,452	2,646	Tungsten	3,000?	5,430?
Cadmium	321	610	Cobalt	1,480	2,696	Carbon	3,600?	6,510?
Lead	327	621	Chromium	1,520	2,768			

Properties of Elements and Metal Compositions

ELEMENTS	SYMBOL	DENSITY (SPECIFIC GRAVITY)	WEIGHT PER CUBIC FOOT	SPECIFIC HEAT	MELTING POINT	
					DEGREES CENTIGRADE	DEGREES FAHRENHEIT
Aluminum	Al	2.7	166.7	0.212	658.7	1217.7
Antimony	Sb	6.69	418.3	0.049	630	1166
Armco Iron		7.9	490.0	0.115	1535	2795
Carbon	C	2.34	219.1	0.113	3600	6512
Chromium	Cr	6.92	431.9	0.104	1615	3034
Columbium	Cb	7.06	452.54		1700	3124
Copper	Cu	8.89	555.6	0.092	1083	1981.4
Gold	Au	19.33	1205.0	0.032	1063	1946
Hydrogen	H	0.070*	0.00533		—259	—434.2
Iridium	Ir	22.42	1400.0	0.032	2300	4172
Iron	Fe	7.865	490.9	0.115	1530	2786
Lead	Pb	11.37	708.5	0.030	327	621
Manganese	Mn	7.4	463.2	0.111	1260	2300
Mercury	Hg	13.55	848.84	0.033	—38.7	—37.6
Nickel	Ni	8.80	555.6	0.109	1452	2645.6
Nitrogen	N	0.97*	.063		—210	—346
Oxygen	O	1.10*	.0866		—218	—360
Phosphorus	P	1.83	146.1	0.19	44	111.2
Platinum	Pt	21.45	1336.0	0.032	1755	3191
Potassium	K	0.87*	54.3	0.170	62.3	144.1
Silicon	Si	2.49	131.1	0.175	1420	2588
Silver	Ag	10.5	655.5	0.055	960.5	1761
Sodium	Na	0.971	60.6	0.253	97.5	207.5
Sulphur	S	1.95	128.0	0.173	119.2	246
Tin	Sn	7.30	455.7	0.054	231.9	449.5
Titanium	Ti	5.3	218.5	0.110	1795	3263
Tungsten	W	17.5	1186.0	0.034	3000	5432
Uranium	U	18.7	1167.0	0.028		
Vanadium	V	6.0	343.3	0.115	1720	3128
Zinc	Zn	7.19	443.2	0.093	419	786.2
Bronze (90 Cu 10 Sn)		8.78	548.0		850–1000	1562–1832
Brass (90 Cu 10 Zn)		8.60	540.0		1020–1030	1868–1886
Brass (70 Cu 30 Zn)		8.44	527.0		900–940	1652–1724
Cast Pig Iron		7.1	443.2		1100–1250	2012–2282
Open Hearth Steel		7.8	486.9		1350–1530	2462–2786
Wrought Iron Bars		7.8	486.9		1530	2786

*Density compared with air.

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derstanding of liquefied petroleum gas, its characteristics and applications, as well as to furnish information that will be helpful in increasing sales and insuring maximum safety.

Pocket Guide sheets, 6¾x3¾", are inserted in a serviceable blue and yellow leatherette six-ring looseleaf binder. The binder, complete with all pages published to date, may be secured for 50 cents, prepaid, by writing The Bastian-Blessing Co. Supplementary looseleaf pages will be mailed from time to time without additional charge for as long as the present publishing procedure is used, to all binder holders.

» «

Defense Booklet

"Dollars for Democracy," a pamphlet describing the growth of the nation's defense appropriations, the effects of our expenditures for defense on the national economy, and the ways in which we will raise the money, was released today by the Division of Information, Office for Emergency Management.

"Dollars have played an important part in the development of our economy," the pamphlet says. "Dollars can play a vital role in the mobilization of our resources for defense—in permitting a productive effort limited only by our ability to mobilize manpower and materials. However, dollars cannot supply the will to produce weapons, the will to resist an invader, the will to vanquish the most powerful armies of aggression the world has ever known.

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» «

Welder Catalog

The **Dyer Welder and Engineering Co.**, Kansas City, Mo., have just published a twelve page catalog describing the **Rex Spot Welder.** The many features of this spot welder are pointed out and discussed. The catalog is also profusely illustrated, picturing the many different models of welders manufactured by the Dyer Company. There is also included, information regarding specifications, accessories and supplies, as well as pictorial views of the Dyer Welder and Engineering Company's plant.

» «

Furnace Bulletin

"Furnaces for Armament" is the title of a new 8 page bulletin which has been released by the **Lindberg Engineering Co.**, Chicago. With many illustrations picturing actual operations, it is shown how heat treated furnaces are used in the manufacture of defense equipment. In the discussion, there is included information regarding aircraft parts, gun mounts, cartridge cases, clips and links, machine gun parts and tank parts. In addition there is included information regarding the Lindberg Engineering Service, designed to furnish information on proper heat-treating as well as to serve as an efficient guide in the develop-

ment and perfection of furnace equipment.

» «

Welding Equipment Bulletin

Equipment and supplies for use in arc welding are described in a new 11-page bulletin announced by the **Westinghouse Electric and Manufacturing Co.** Several types of electrode holders are described and a general discussion gives the major requirements for a good all-around electrode holder. FlexArc helmets, handshields, super-filter lenses, and protective clothing, such as gloves, aprons and sleevelets, made of chrome leather are described. Cable connectors of from 200 to 500 ampere sizes are discussed.

Illustrations of all items and tabulations giving sizes, order numbers and prices are included. A copy of catalog section **26-620** may be secured from department 7-N-20, Westinghouse Electric and Manufacturing Co., E. Pittsburgh, Pa.

» «

Rubber Abrasive Catalog

The wide application and use of **Weldon Roberts Brightboy** soft rubber light abrasives for pre-polishing, polishing and finishing many types of metals, are described in both a new price list (No. 53) and a new illustrated leaflet. Manufactured by specialists with years of experience in rubber compounding, Brightboy is made in a number of sizes in wheels and discs for use on lathes, as well as in sticks and tablets for hand work. Its unique soft rubber binder cushions the abrasive.

Both the new Brightboy catalog and leaflet may be obtained by writing the Brightboy Industrial Division, **Weldon Roberts Rubber Co.**, Newark, N. J.

Recent Patents

Welding Method

2,256,924. **Robert K. Hopkins**, New York, N. Y., assigned to **M. W. Kellogg Co.**, New York, N. Y. Filed Mar. 25, 1938. Issued Sept. 23, 1941. The method of welding armor metal having a hard penetration-resisting zone, whose penetration-resisting characteristics are reduced by heat, and a weldable tough backing zone integrally united thereto which comprises forming a welding groove substantially only in the backing zone of the edges to be joined, abutting the edges of the metal of the penetration-resisting zone overlying the formed welding groove and filling the groove with metal supplied by arc deposition from a fusible electrode to weld together the edges of the backing zone and to leave unconnected the edges of the penetration-resisting zone. The electrode is of small size. The electrode is traversed at a rate sufficiently high to prevent the temperature of the metal of the penetration-resisting zone being raised to a temperature at which material softening takes place.

» «

Butt Welding

2,258,913. **Albert L. Stone**, Palos Verdes Estates, Calif., assigned to **Hydril Co.**, Los Angeles, Calif. Filed Mar. 20, 1940. Issued Oct. 14, 1941. Ends of tubular members are butt welded with the use of an internally fitted metal ring. The ring cooperates with an outer groove between the edges of the ends to be joined. Weld material deposited in the groove penetrates the ring, and when the weld is completed, the ring with its weld-material-content is cut away from the welded joint.

» «

Atomic Hydrogen Welding

2,259,118. **Gareth G. Somerville**, Pittsfield, Mass., and **James T. Catlett**, Scotia, N. Y., assigned to **General Electric Co.** of New York. Filed July 12, 1940. Issued Oct. 14, 1941. The patent describes a method and apparatus in which the arc of an atomic hydrogen torch is drawn down between closely spaced work clamps and held exactly on the seam between the plates positioned in these clamps. The arc is stabilized through the use of a magnetic flux which acts on the arc after spanning a

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high reluctance gap directly underneath the seam between the parts being welded.

» «

Tool Joint Welding

2,257,335. **Seth Evans** and **Richard S. Grant**, Houston, Tex., assigned to **Hughes Tool Co.**, Houston, Texas. Filed April 5, 1940. Issued Sept. 30, 1941. In welding tool joints the steps including forming upon the pipe ends of externally upset areas having a short cylindrical outer surface and a short tapered shoulder, forming the tool joint with comparatively thick walls and with a reduced diameter at the end to be welded so that there is a tapered area and a cylindrical wall on the joint of the same thickness as the pipe end, flash welding the ends of the joint and pipe together to burn off most of the cylindrical areas of pipe, and joint, and making a weld upon the tapered area formed by the tapered portions of the joint and pipe.

» «

Welding Electrode

2,257,566. **George E. Lewis**, Detroit, Mich., assigned in part to **Bert L. Guarnstrom**, Detroit, Mich. Filed May 29, 1939. Issued Sept. 30, 1941. The method of forming welding electrodes comprising the forming of a solid tip with an end portion reduced in diameter and undercut, and contracting a tubular portion of a shank about the end portion thereby applying pressure normal to the contacting surfaces to form an interlocking highly electrically conductive and sealing mechanical joint. The tip is formed from a copper alloy having at working temperature an increased rigidity and slightly decreased electrical conductivity in comparison with commercial copper. The shank is formed of commercial copper. The interlocking joint between the tip and shank resists tension as well as compressive stresses. The tip and shank are concentric with a common axis so as to be always accurately aligned with the cooperating electrode.

» «

Welded Structural Member

Reissue 21,921. **Gerald G. Greulich**, Mount Lebanon, Pa. Original No. 2,108,373. Reissue filed Dec. 20, 1939. Issued Oct. 14, 1941. A method of making a beam which includes forming an elongated sheet metal web having longitudinally extending edge portions, forming an elongated unitary sheet metal flange comprising laterally opposite integrally connected flange portions and an inwardly open groove extending longitudinally therealong, seating an edge portion of the web in the groove and welding the edge portion of the web to the side walls of the groove.

» «

Welding Flux

2,258,675. **Willi M. Cohn**, El Cerrito, Calif. Filed Feb. 12, 1941. Issued Oct. 14, 1941. The patent describes an electric arc welding flux comprising a major portion of anhydrous crystalline mullite and being substantially devoid of free silica.

» «

Welding Method

2,258,739. **James H. Bucknam**, Cranford, and **Winslow B. M. Clark**, Roselle, N. J., assigned to **The Linde Air Products Co.**, of Ohio. Filed Oct. 31, 1939. Issued Oct. 14, 1941. There is shown a method of simultaneously welding an entire seam which comprises arranging metallic members to be weld united with their adjacent edges in substantially abutting relation to form a line to be welded; clamping the members in position to be welded; disposing at a short distance beneath the line to be welded an element having a high coefficient of heat conductivity; impinging against the line to be welded a series of closely spaced oxy-fuel gas heating flames substantially coextensive in length with the line; and oscillating the flames longitudinally of the line throughout a distance of the order of the spacing between the flames. The heating is continued until the metal of the edges fuses, commingles, and drops onto the heat conductive element. Then the heating flames are withdrawn to permit the fused metal to solidify with the heat conductive element.

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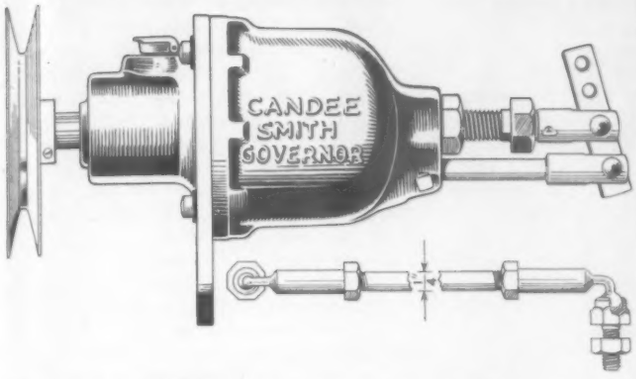

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Making Tool Joints

2,258,751. **Seth Evans,** Houston, Tex., assigned to **Hughes Tool Co.,** Houston, Texas. Filed April 27, 1940. Issued Oct. 14, 1941. In welding a tool joint to a drill pipe end where the wall thickness of the joint is greater than that of the pipe, the steps of enlarging the diameter of the pipe end, heating the adjacent ends of the joint and pipe to a plastic state, pushing the ends forcibly together to upset the plastic metal at the ends, and cutting away the metal thus upset to the same outer and inner diameter as the tool joint end so that the upset metal on the inner surface will form a thickened end upon the pipe side of the weld line.

» «

Portable Welder

2,256,028. **Albert D. Jardine** and **Harry V. Beronius,** Detroit, Mich. Filed Mar. 17, 1941. Issued Sept. 16, 1941. In portable welding devices of the character in which the electrodes are moved toward each other by a fluid pressure operated power element, it is the usual practice to connect the power element, to a source of pressure, such as a master cylinder or prime mover, by a rubber hose. Because of the high pressure required to obtain good welding results, the hose, connecting the welder to a fluid pressure source, must be reenforced to the extent where it is substantially rigid. As a result, a workman cannot twist the hose and on occasions finds it difficult, if not impossible, to reach certain out of the way places to be welded. An object of this invention is to provide a portable welder having a power element so constructed as to permit swiveling of the welder relative to the hose connecting the power element to a source of fluid pressure. The device is also fluid tight. The welding device has one electrode carried by a reciprocating cylinder. There is an open ended tubular piston in the cylinder and a flexible conduit to a source of fluid pressure to move the cylinder in one direction. The cylinder is reciprocable relative to the piston. The structure provides the necessary swiveling movements to facilitate manipulation of the electrodes.

» «

Welder's Glove

2,256,427. **Harry N. Gitt, 2nd,** Hanover, Pa. Filed April 18, 1940. Issued Sept. 16, 1941. The device forming the subject matter of this patent is a hand covering, adapted primarily for welder's use. It is known that the sparks from a welder's torch catch in the seams of the hand covering, working a rapid destruction of the article. The present invention aims to provide an article in which there are no seams along the longitudinal edges, the seams being confined to the front or palm side of the glove, additional security against the sparks being avoided by reason of the fact that when the hand of the workman is closed about the welding tool, the seams, for the most part, are definitely prevented from gathering sparks. The glove comprises a back part, front and back gauntlet parts, a thumb back, and front and back index finger parts integral therewith. A continuous seam joins the front gauntlet parts, and extends to join the thumb back and the thumb front and the other parts.

» «

Welding Gun

2,256,480. **Grover A. Hughes,** Seattle, Wash. Filed Sept. 3, 1940. Issued Sept. 23, 1941. Among the several objects of this invention are: to provide for initiating the welding arc without conductive contact between the parts to be welded; to utilize a high frequency potential to break down the air gap between spaced electrodes to initiate the arc; to use either alternating or direct current in the welding circuit; and to time the duration of the arc with a high degree of accuracy. The apparatus comprises a support for an element to be end-welded at a proper arc distance from the work piece to which the element is to be welded. A unit for applying a high frequency potential between the element and the work and a supply of alternating current serve to break down the air gap between the element and the work and to establish the arc. The welding current is interrupted by a unit responsive to a predetermined number of alternations of the current. Welding contact of the element and the work is also established after a predetermined interval.

» «

Welding Apparatus

2,256,246. **John F. Geibel,** Buffalo, N. Y., assigned to **Master Metal Products, Inc.,** Buffalo, N. Y. Filed Oct. 6, 1939. Issued Sept. 16, 1941. In a welding apparatus, a frame having relatively movable electrode-supporting members mounted thereon between which the work to be welded is adapted to be placed, a plurality of fixed electrodes applied to one of the members, a plurality of companion electrodes applied to the other member, normally-open, circuit-closing contacts operatively associated with the displaceable electrodes, and means operatively connected to the respective contacts of the displaceable electrodes for bringing them into circuit-closing relation in predetermined sequence to successively render the companion sets of electrodes operative.

» «

Welding Support

2,256,879. **Edward S. Cornell, Jr.,** Larchmont, N. Y. Filed Dec. 2, 1938. Issued Sept. 23, 1941. A device is described in which the portions of a structure to be welded are suitably and fixedly supported against any tendency to separate by reason of the weight of the portions, inherent springable characteristic of the metal, or like cause. The invention also provides means affording the rapid conduction or transfer of heat to prevent the weld material from adhering to the matrix establishing the ultimate configuration and amount of the welding. A substantially uniform and pre-established amount of weld-metal deposit is obtained, thereby insuring an adequate factor of safety of the strength of the welded joint. The invention is applicable to the making of longitudinal body seam welds in pressure vessels where the strength of the welded joint must be adequate, and in which it may be desirable that the configuration of the weld internally of the tank structure be uniform, free from pockets, and thus adaptable to complete scouring or other treatment.

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